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Ontario Geological Survey
Open File Report 6042

Precambrian Geology of the Watabeag Lake Area

2001

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ONTARIO GEOLOGICAL SURVEY

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Precambrian Geology of the Watabeag Lake Area

by

C. Vaillancourt

2001

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Contents

Abstract xi

Introduction 1

History of Exploration 2

Previous Geological Work 2

Present Geological Survey 2

Acknowledgements 3

General Geology 3

Description of the Assemblages 5
- Tisdale Assemblage 5
- Kinojevis Assemblage 5

Description of Rock Units 6
- Mafic Metavolcanic Rocks 6
  - Flows 6
  - Tuff and Lapilli Tuff 6
- Intermediate to Felsic Metavolcanic Rocks 11
  - Flows 11
  - Tuff and Lapilli Tuff 11
  - Crystal Tuff 12
- Metasedimentary Rocks 13
  - Mudstone-Siltstone 13
  - Conglomerate 15
- Mafic and Ultramafic Intrusive Rocks 15
  - Metagabbros 15
  - The Nordica Intrusion 17
- Intermediate to Felsic Intrusive Rocks 20
  - Syenite 20
  - Granodiorite 21
  - Porphyry Dikes 22
  - Diabase Dikes 22

Quaternary Formations 23

Metamorphism 23

Structure 24

Alteration 27

Geochemistry 30
- Methodology 30
- Classification 31
  - Metavolcanic Rocks 31
  - Mafic Intrusive Rocks 34
    - The Nordica Intrusion 35

Felsic Intrusive Rocks 36
Mineralisation 40
The Cross Lake Discovery 40
The Dougherty Lake Area 42
The Nordica Intrusion 42
Gold 44
Recommendations 44
Appendix 1 46
Appendix 2 56
References 58
Metric Conversion Table 61

FIGURES

1. General location map for the Watabeag area 1
2. Assemblages in the Watabeag area and location of the areas and batholiths 4
3. General geology of the Watabeag area 8
4. Major structural components of the Watabeag area 25
5. Major elements discrimination diagrams 32
6. Chondrite normalised rare-earth elements plot of the metavolcanic rocks 33
7. Chondrite normalised rare-earth elements plot of the mafic intrusive rocks 34
8. Classification diagram for the Nordica intrusion lithologies 35
9. Chondrite normalised rare-earth elements patterns of the different lithologies from the Nordica intrusion 36
10. Classification of the felsic intrusive rocks of the Watabeag area 37
11. Chondrite normalised rare-earth element plot of the felsic intrusive rocks 38
12. Al_2O_3, CaO, Na_2O and K_2O in the felsic intrusive rocks of the Watabeag area 39
13. Mantle-normalised multiple elements diagram of PGE, Ni, Cu and Au 43

PHOTOS

1. a) Variolitic pillowed flow, Timmins Township; b) Large-scale varioles in mafic flow, Michie Township 9
2. Recrystallized a) pillowed flow and b) breccia, Nordica Township 10
3. Graded heterolithic tuff, Sheraton Lake zone, Sheraton Township 12
4. Crystal tuff, Sheraton Township 12
5. Folding in argillites, Dougherty Lake area, Timmins Township 13
6. Photomicrograph of andalusite porphyroblasts in an argillite, Timmins Township 14
7. Polymictic conglomerate and sandstone, Michie Township 14
8. Coarse-grained gabbro, Timmins Township 16
9. Troctolite from the Nordica intrusion, Nordica Township 17

10. Magmatic layering in the troctolites of the Nordica intrusion, Nordica Township 18
11. Cumulate texture in an olivine gabbronorite from the Nordica intrusion, Nordica Township 18
12. Very coarse amphibolite intruding the troctolites of the Nordica intrusion, Nordica Township 19
13. Thin section of a chromitite from the Nordica intrusion, Nordica Township 20
14. Two phases of the Bradley Lake syenite, Egan Township 21
15. Partial melting in the mafic volcanic rocks of the Kinojevis assemblage, Nordica Township 24
16. Web texture resulting from intense veining, Timmins Township 28
17. Propagation of alteration from a vein, Timmins Township 29
18. Biotite-garnet alteration in a pillow breccia, Timmins Township 29
19. Hydrothermal breccia in core sample, Timmins Township 30

TABLES

1. Lithological units for the Watabeag area 7
2. Summary of significant intersections from the Cross Lake Property, Sheraton Township 40
3. Geochemical analysis of PGE and Au obtained by Band-Ore Resources Limited for the Nordica intrusion. 42
4. Geochemical analysis for the PGE, Au and Re for the Nordica intrusion. 43

Abstract

The geology of the Watabeag Lake area described in this report integrates the results of fieldwork accomplished in the summers of 1998 and 1999 along with compilation work, geochemistry, petrography and drill core logging. All available geophysical data was also used to interpret contacts and structural features, especially in areas where outcrops or drill core are rare or absent.

The area is underlain by Archean metavolcanic and metasedimentary rocks of the Tisdale and Kinojevis assemblages. Large felsic batholiths are intruded in the volcanic rocks and cover over half of the map area. Dikes from the Paleoproterozoic Matachewan and the Mesoproterozoic Abitibi swarms cut the above units. Mafic tholeiitic rocks of the Tisdale assemblage are found on the westernmost part of the map. They are overlain by calc-alkaline rocks that are part of the same assemblage. These units consist of massive and pillowed mafic flows and felsic to intermediate tuffs, lapilli tuffs and crystal tuffs. Mafic tholeiitic flows of the Kinojevis assemblage sit on top of the Tisdale. Thick sequences of massive and pillowed mafic flows of tholeiitic affinity form this assemblage and a large portion of the flows are variolitic. Mafic and ultramafic intrusive rocks in the area include gabbroic dikes of variable composition and a small layered intrusion located in Nordica Township. The felsic plutonic rocks are mostly hornblende-granodiorite and biotite-granodiorite but an alkalic pluton composed of syenite and monzonite is also found in the eastern part of Sheraton Township.

The Archean rocks have undergone regional greenschist facies metamorphism. Amphibolite facies mineral assemblages are also found as a result of contact metamorphism near the large felsic intrusive bodies. NNW penetrative schistosity is the strongest structural component and has in many sectors obscured stratigraphic direction. From the contact pattern between the Tisdale and Kinojevis assemblage, large folds related to this deformation are suspected. A large synclinorium centered on the Bradley Lake syenite is also interpreted from the reversal of top direction north and south of the pluton.

The Watabeag Lake area has seen substantial exploration work throughout the years. VMS-style mineralisation was found in the upper portion of the Tisdale assemblage. The mafic flows of the Kinojevis assemblage contain multiple gold prospects. There is also a high potential for PGE or Ni-Cu-PGE deposits related to mafic-ultramafic intrusions similar to the Nordica intrusion.

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Introduction

This report integrates the results of two summers of geological mapping of an area centred on the townships of Sheraton, Timmins, McEvay, Michie and Nordica (Figure 1). Sheraton Township was mapped at the 1:20 000-scale but 1:50 000-scale was used for the townships of Timmins, McEvay, Michie and Nordica because of poor outcrop coverage. Data collected from all available diamond drill core has also been added to the maps, especially in sectors characterised by poor or absent outcrop coverage.

Located to the south of highway 101 between Timmins and Matheson, the area is bounded by the approximate latitudes of 48° 11' and 48° 28' and longitudes of 80° 31' and 80° 50' totalling close to 600 km^2. It is accessible from Gibson Lake road in the west, Currie-Bond road in the center and Watabeag road in the east, those three gravel roads extending south from highway 101. Many branching secondary roads and trails give easy access to most portions of the area.

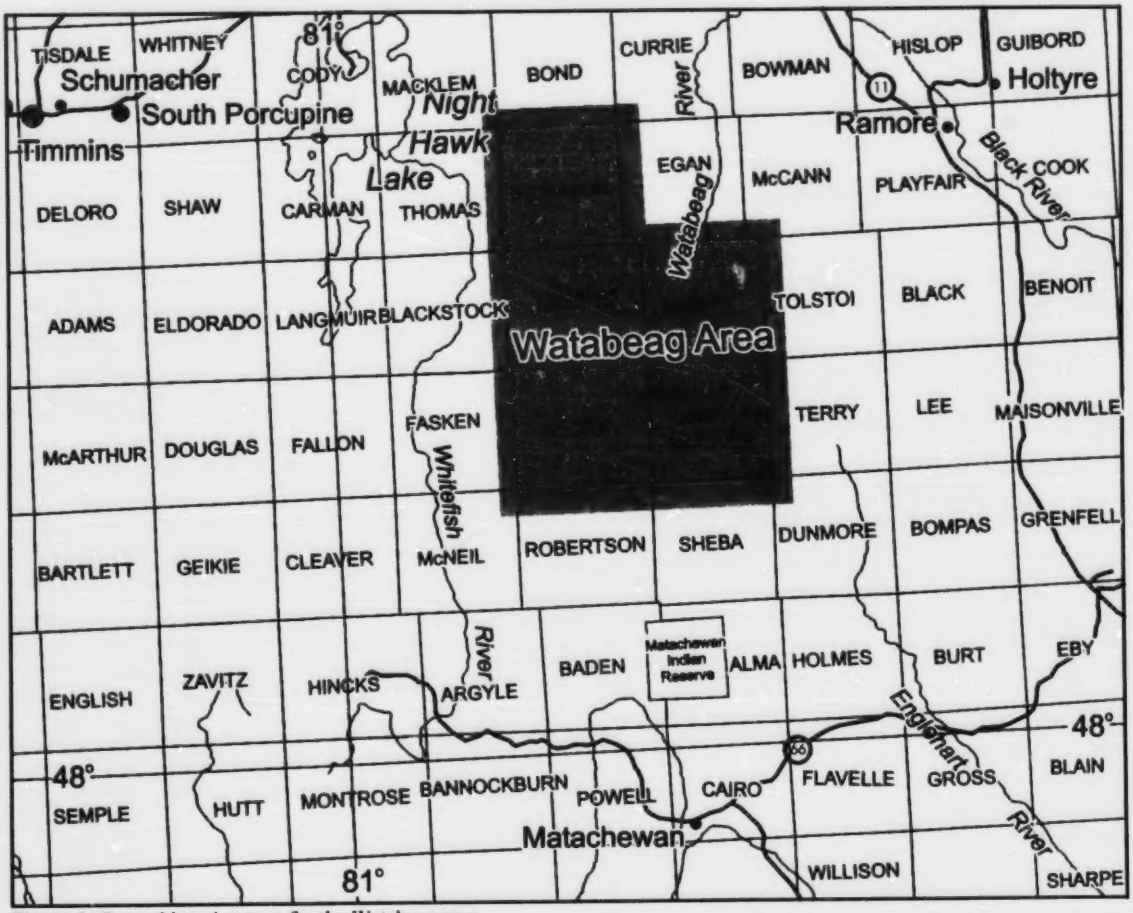

Figure 1. General location map for the Watabeag area.

History of Exploration

The Watabeag area was the location of multiple exploration projects by companies and prospectors for gold and base metals throughout the years. Important data from recent projects were used in the compilation of the maps and reports related to the present work. These exploration projects are briefly described below.

Extensive exploration work including diamond drilling, geophysics, and lithogeochemistry is still underway in Sheraton Township. Major work on this project started in early 1997 with the discovery of copper-zinc-lead-silver-gold mineralisation by Cross Lake Minerals Ltd. on their Sheraton-Timmins property. The company had acquired this property in 1991 and completed ground magnetic and horizontal loop electromagnetic (EM) surveys on it. The drilling of geophysical targets in 1993 revealed anomalous Zn and Cu values. Following the 1997 discovery, exploration work was also carried out by the Night Hawk Lake Joint Venture (Golden Knight Resources Inc. - Cross Lake Minerals Ltd. - East West Resource Corp. - Canadian Golden Dragon Resources Ltd.) on the Sheraton Lake property, just north-east of the Sheraton-Timmins property.

The Dougherty Lake area was also the target of extensive exploration work, first by prospectors, and then by East-West Resource Corp. and Canadian Golden Dragon Resources Ltd which performed ground geophysical surveys and geological mapping in 1993. Optioned by Royal Oak Mines Inc., and then by International CanAlaska Resources Ltd., further exploration work including diamond drilling was completed.

Another recent project of importance in the area is related to the discovery of platinum-group elements (PGE) showings in a mafic-ultramafic layered intrusion in Nordica Township. Band-Ore Resources Ltd. has performed geological and geophysical and geochemical work as well as diamond drilling in the area of the discovery.

Exploration work for base metals and gold was carried out on many other properties in the Watabeag area and important results are available in assessment files at the Resident Geologists' Offices in South Porcupine and Kirkland Lake.

Previous Geological Work

Berry (1940) first mapped portions of the area at 1:63 360-scale. The entire area was later included in compilation maps by Ginn et al. (1964) and by Pyke et al. (1973) at the 1:253 440-scale. Pyke (1976) remapped the area with the exception of the southern portion of Michie and Nordica townships at a scale of 1:63 360.

Present Geological Survey

The author and a field assistant spent half the summer of 1998 mapping outcrops in the south-east corner of Sheraton Township. The other half was used to examine diamond-drill core mostly from the Cross Lake and the Sheraton Lake zones (see Figure 2), which was provided by Cross Lake Minerals Ltd. and Golden Knight Resources Inc. Core from the south-west corner of Sheraton Township and north-east corner of Thomas Township stored at the Ministry of Northern Development and Mines, Drill Core Library in Timmins was also studied. Where core was not available, information from diamond-drill logs

in assessment files was also considered. Bedrock samples from Sonic drilling by the Ministry of Northern Development and Mines in Sheraton, Egan and Thomas townships were also described. All information was compiled on a preliminary map (Vaillancourt 1999a) at 1:20 000-scale and a Summary of Field Work was published (Vaillancourt 1999b). Airborne geophysical data was extensively used for geological interpretation.

The Watabeag area, centered on Timmins, Michie, McEvay and Nordica townships, was covered during the summer of 1999. The mapping crew consisted of the author and three assistants. As for Sheraton Township, the summer work was split between outcrop mapping and diamond-drill core description. Access to core was provided by Royal Oak Mines Inc. and International CanAlaska Resources Ltd. Information from diamond-drill logs from assessment files was added to the map in areas where core was not available to the author. Airborne geophysical data was again a very important tool for the tracing of contacts between the larger units and also for the positioning of numerous diabase dikes on the map. All the compiled data was published in a 1:50 000-scale preliminary map (Vaillancourt 2000) and a Summary of Field Work (Vaillancourt 1999c).

Acknowledgements

Mapping in the Watabeag area would not have been possible without the full cooperation of exploration companies who have given full access to their diamond drill core. The data gathered from drill core allowed the addition of information on areas where outcrops are rare to completely absent. Cross Lake Minerals Ltd. and Golden Knight Resources Ltd. provided access to drill core and logs, geochemical data and maps as well as discussion with their geologists, all of which brought valuable information to the maps and reports. Cross Lake Minerals Ltd. also provided digital airborne geophysical data covering an important portion of the area. International CanAlaska Resources Inc. and Royal Oak Mines Ltd. gave access to their diamond-drill core. Geochemical data and drill core logs from Band Ore Resources Inc. were made available through prospectors owning properties in the map area.

The author wishes to thank the geologists of the various companies, the Resident Geologist's Office in South Porcupine and Kirkland Lake, university researchers and my colleagues from the Ontario Geological Survey who provided advice and opinion on various aspects of the geology of the Watabeag area. Very good exchanges of ideas resulted in the addition of valuable data to the maps and reports.

Fieldwork was accomplished with success because of the valued help, interest and support of the summer assistants. Summer-1998 assistant Francis Roy and summer-1999 assistants Hugues Longuépée, Alexander Watson-White and Chanelle Lépine are warmly thanked for their excellent work.

General Geology

The area is composed of Archean volcanic and plutonic rocks of the Abitibi greenstone belt, cut by Proterozoic diabase dikes. Located between the Porcupine-Destor deformation zone to the north and the Larder Lake-Cadillac deformation zone to the south, the area includes portions of several assemblages defined by Jackson and Fyon (1991): the Watabeag assemblage, the Bowman assemblage and the Kinojevis North and South assemblages. According to the redefinition by Ayer et al. (1999a, 1999b), the area now includes portions of the 2708-2702 Ma Tisdale and 2701 Ma Kinojevis assemblages (Figure 2).

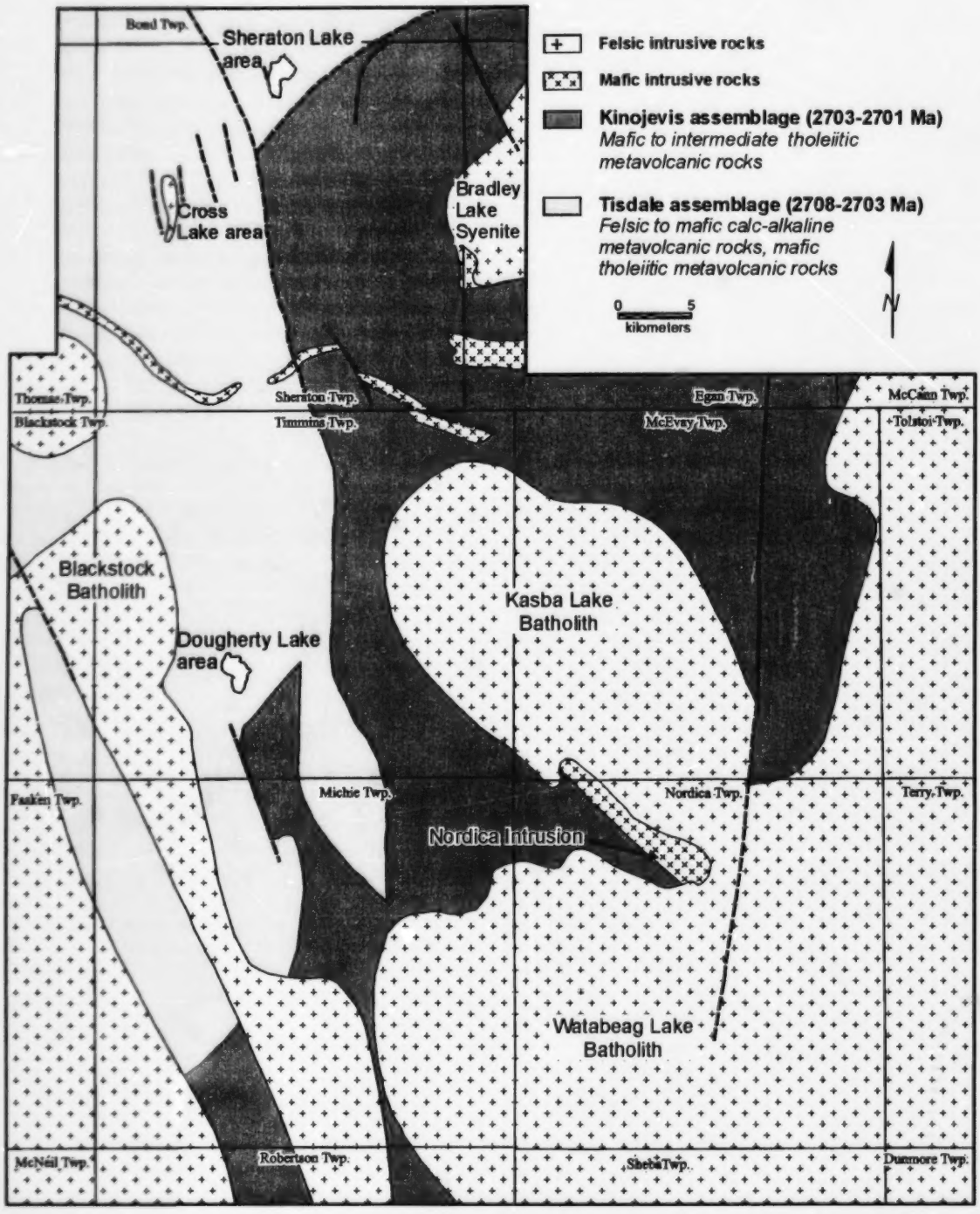

Figure 2. Assemblages in the Watabeag area and location of the areas and batholiths referred to in this report.

The volcano-sedimentary assemblages are intruded by multiple batholiths, almost exclusively granodioritic in composition. Following the nomenclature of Pyke 1976, the Blackstock Granodiorite covers the westernmost portion of the area and the Kasba Lake Granodiorite and the Watabeag Lake Batholith are found in the center and the east. These rocks are all cut by the diabase dikes of the Matachewan swarm and finally, by the diabase dikes of the Abitibi swarm.

Description of the Assemblages

The notion of tectonic assemblage was described by Thurston (1991) as consisting of stratified volcanic and/or sedimentary rock units built during a discrete interval of time in a common depositional or volcanic setting. The contact relationships between assemblages can be conformable, unconformable or tectonic.

As previously mentioned, portions of two distinct assemblages defined by Ayer et al. (1999a) underlie the map area. They are the Tisdale and the Kinojevis assemblages. These assemblages are defined on the basis of lithofacies, geochemistry and age. Rocks within an assemblage also have similar styles of alteration, deformation and geophysical signatures. The latter has revealed to be of great importance in the definition of the contacts on the map since they were not observed on outcrops.

TISDALE ASSEMBLAGE

The Tisdale assemblage comprises rocks of ages from about 2708 to 2702 Ma (Ayer 1999b). It can be divided into three distinct suites. The lower portion of the assemblage is represented by tholeiitic to komatiitic rocks and the upper portion is largely composed of felsic and intermediate but also mafic calc-alkaline rocks. Locally preserved iron formation is the third component of the assemblage. Portions of the two first suites are present in the map area. A small portion of the lower Tisdale is present in the north-west of the area and underlies the upper Tisdale located to the east of it (Figure 2). The younger Kinojevis assemblage overlies the Tisdale assemblage, toward the east.

KINOJEVIS ASSEMBLAGE

The Kinojevis assemblage represents a thick sequence of tholeiitic largely mafic flows, minor rhyolite with scarce interflow metasedimentary rocks (Jackson and Fyon 1991) and very local interbedded iron formations, tuffs and clastic metasedimentary rocks (Thompson and Griffis 1944; Goodwin 1979). The mafic volcanic rocks form a sequence of high iron and high magnesium tholeiites. Some flows have very well developed variolitic textures and/or local feldspar-phyric textures (Jensen and Langford 1985; Fowler et al. 1987). Thin felsic flows near the top of the assemblage give ages of 2701±3 Ma (Corfu 1993) and 2701±1 Ma (Berger and Amelin 1999)

The relatively short time interval between the Tisdale assemblage and the top of the Kinojevis assemblage implies that the two assemblages are most likely conformable and that the mafic volcanic flows of the Kinojevis assemblage were accumulated within a short period of about 2-3 million years (Ayer et al. 1999a).

In the map area, contacts between the Tisdale and the Kinojevis assemblages have not been observed directly. They are thus inferred to be conformable, unless major deformation zones were observed in the vicinity of the interpreted contacts (see Structure, this report).

Description of Rock Units

The different lithologies found in the Watabeag area are presented in Table 1. Major units are represented on Figure 3.

MAFIC METAVOLCANIC ROCKS

Flows

The most common type of mafic metavolcanic rocks in the area is represented by successions of pillowed flows, pillow breccias and local massive flows cut by synvolcanic gabbro dikes (Figure 3). The pillowed flows are by far the most abundant. The size of the pillows is largely variable, approximately from 30 cm by 20 cm up to 2 m by 40 cm. A large fraction of the outcrops display intense deformation and it is thus difficult to assess the original size of the pillows as they are flattened and/or stretched. Pillow selvedges are thin (< 2 cm) and where recognisable, interpillow material consists of hyaloclastite and is never more abundant than 5% of the rock.

The massive flows but more commonly the pillowed flows are locally variolitic (Photos 1a-b). The variolitic units are always tholeiitic in composition and are thus interpreted to represent the Kinojevis assemblage although not all flows of this assemblage are variolitic. Large plutonic bodies have induced contact metamorphism in portions of the flows, resulting locally in intense recrystallization. Photo 2 shows a radial arrangement of the mafic and the felsic minerals following the shape of the pillows (a) and that of the breccia fragments (b).

Porphyritic massive and pillowed flows as well as pillow breccia were determined to be of calc-alkaline affinity (see Geochemistry, this report). Phenocrysts are plagioclase, hornblende or both. Where observed, these flows are intensely altered (the Dougherty Lake area), with a pale grey color and locally contain garnet, possibly resulting from alteration. In the area, the porphyritic texture seems to be strictly restricted to the calc-alkaline flows and are thus interpreted to be portion of the Upper Tisdale assemblage.

Very few younging directions were deduced from the pillowed flows. In most areas, the pillows are too flattened to recognise the cusps. Only locally less deformed pillowed flows in south-east Sheraton and north Nordica townships have revealed non-equivocal top directions.

Multiple veins of variable composition cut both the tholeiitic and the calc-alkaline flows. Quartz and epidote are the most common minerals in veins but carbonates and chlorite locally accompany them.

Tuff and Lapilli Tuff

Mafic tuffs and lapilli tuffs are generally scarce in the map area. They were observed in core from the Dougherty Lake area but not in outcrops. This could mean that the weathering has preferentially preserved the pillowed flows and breccias to the volcaniclastic flows. Mafic lapilli tuffs are also present in the Sheraton Lake area (Figure 3) but most of the volcaniclastic rocks there have a more intermediate composition.

Table 1. Lithological units for the Watabeag area.

PHANEROZOIC
CENOZOIC
QUATERNARY
HOLLOCENE
Lake, stream and wetland deposits
PLEISTOCENE
Glacial, glaciofluvial and glaciolacustrine deposits; sand, gravel, clay, till

UNCONFORMITY

PRECAMBRIAN
PROTEROZOIC
MESOPROTEROZOIC
Mafic intrusions
Abitibi swarm: diabase dikes

INTRUSIVE CONTACT

PALEOPROTEROZOIC
Mafic intrusions
Matachewan swarm: diabase dikes

INTRUSIVE CONTACT

ARCHEAN
Metamorphosed felsic and intermediate intrusive rocks
Syenite, monzonite, hornblende granodiorite, biotite granodiorite, tonalite, feldspar porphyry dikes, quartz feldspar porphyry dyke

INTRUSIVE CONTACT

Metamorphosed ultramafic and mafic intrusive rocks
Gabbro, troctolite, gabbroic and dioritic dikes, hornblendite, olivine gabbronorite, chromitite

INTRUSIVE CONTACT

Clastic and chemical metasedimentary rocks
Wacke, siltstone, mudstone, graphitic and pyritic mudstone, polymictic conglomerate

Tholeiitic mafic to intermediate metavolcanic rocks
Massive and pillowed flows, flow top and pillow breccia, hyaloclastite, tuff and lapilli tuff, graphitic breccia

Calc-alkalic felsic to intermediate metavolcanic rocks
Massive flows, flow breccia, tuff and lapilli tuff, heterolithic tuff breccia, feldspar ± quartz crystal tuff

Calc-alkalic mafic metavolcanic rocks
Massive and pillowed flows, flow top and pillow breccia, hyaloclastite, tuff and lapilli tuff, heterolithic tuff breccia, variolitic units

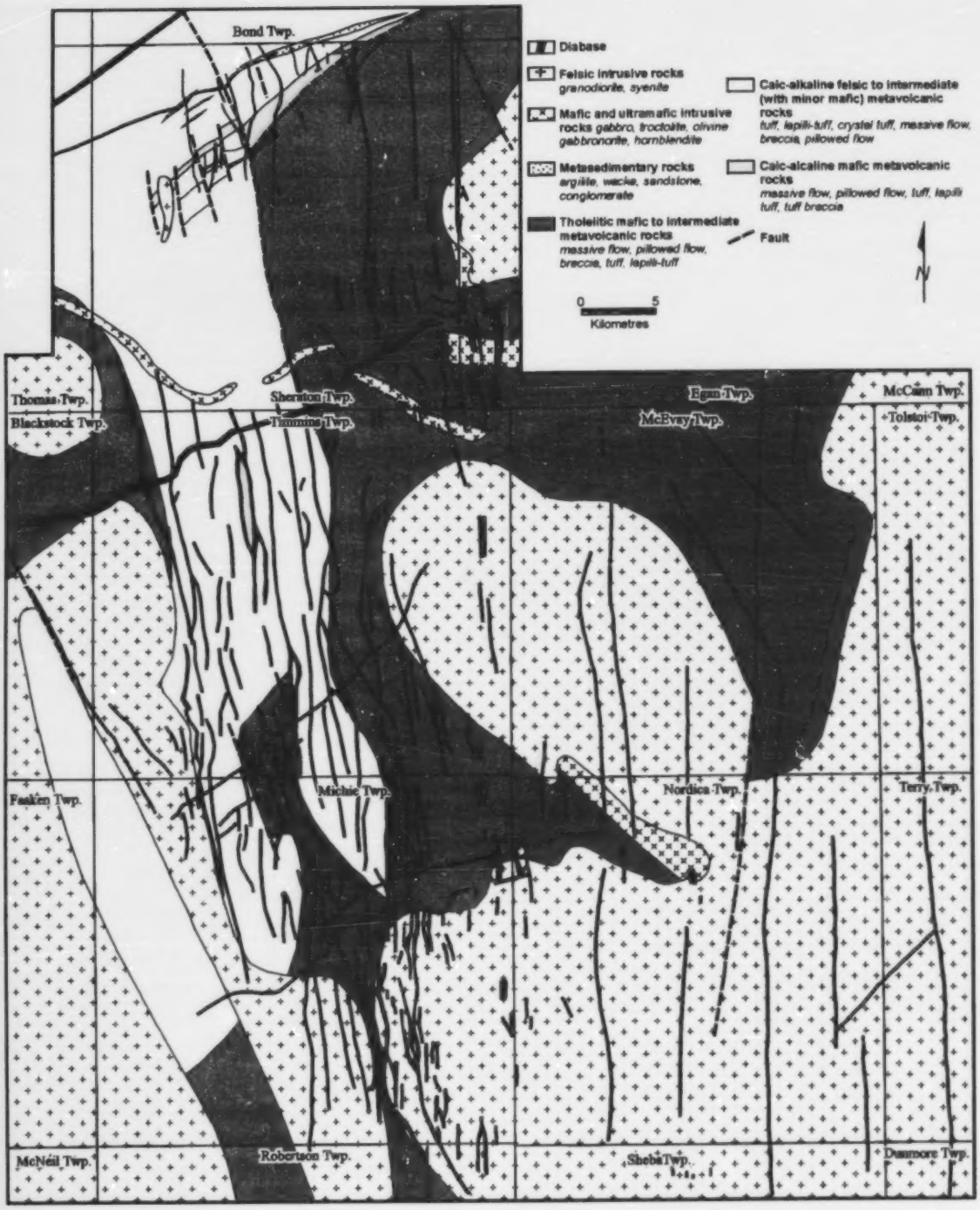

Figure 3. General geology of the Watabeag area.

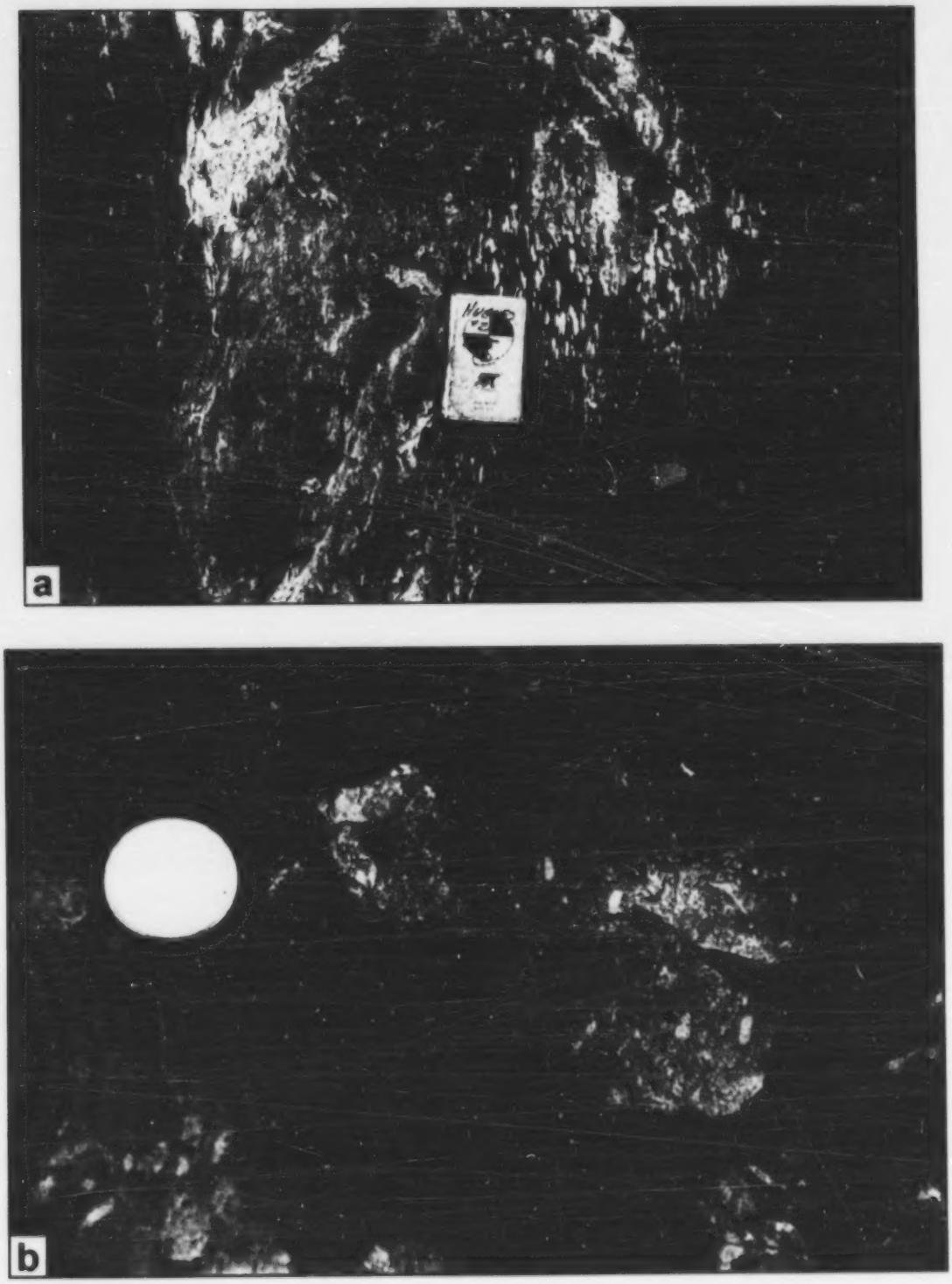

Photo 1. a) Variolitic pillowed flow, Timmins Township; **b)** Large-scale varioles in mafic flow, Michie Township.

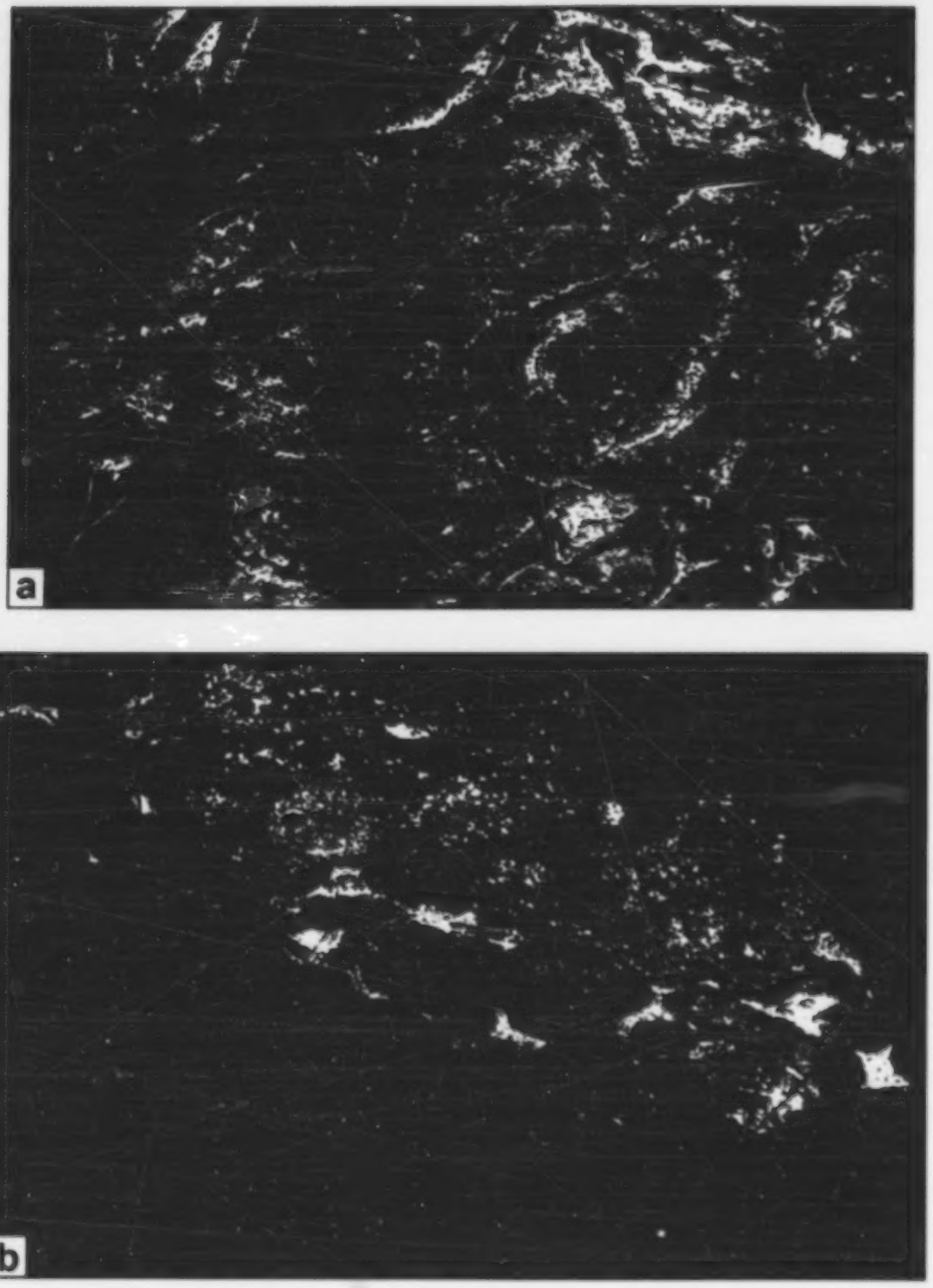

Photo 2. Recrystallized **a)** pillowed flow and **b)** breccia, Nordica Township.

In the Dougherty Lake area, volcaniclastic units observed in core are generally lapilli-tuffs with minor tuffs. They are commonly dark green with 2-3 cm fragments in a biotite rich matrix. Fragments are crystalline and contain the plagioclase and/or hornblende phenocrysts common to the calc-alkaline rocks of the map area. Intense silicification locally gives a pale grey to beige color to the tuff and the fragments become faded. This feature is very common in the silicified zones of the Sheraton Lake and Cross Lake zones.

The mafic lapilli tuffs of the Sheraton Lake area are monolithic with pale green block and lapilli-size fragments in a darker green ash matrix. The components are amphibole and plagioclase porphyritic. The strength of deformation in the unit is highly variable from undeformed to strongly sheared.

INTERMEDIATE TO FELSIC METAVOLCANIC ROCKS

A large fraction of the intermediate and felsic metavolcanic rocks in the map area are volcaniclastic, and very few massive flows have been recognised. They are calc-alkaline in affinity. The volcaniclastic units can be described as successions of tuff, lapilli tuff and crystal tuff with a full range of combinations of fragment types and sizes represented.

Flows

Only minor meter scale rhyolitic intersections of core from the Sheraton Lake area could possibly be interpreted as massive felsic flows, but the very intense, mostly silicic alteration may very well overprint the fragmental nature of the protolith.

Tuff and Lapilli Tuff

Tuffs and lapilli tuffs are the main constituent of the Sheraton Lake-Cross Lake area and further down south-west (east Thomas Township) and south (north Timmins Township). They are also present in the Dougherty Lake area but the dominant rock type appears to be mafic flow.

The size of the fragments varies greatly from fine ash almost to bombs. The tuffs contain mostly monolithic fragments. Intervals of heterolithic fragmental rocks, along with bedding, infer reworking, at least locally. Where not completely altered to sericite or carbonates, the fragments are most commonly composed of very fine quartz and feldspar.

The color of the tuffs varies widely based upon the different types and level of alteration. The most common type of alteration is a combination of silicification and sericitization which give the rock a mustard yellow color. The local presence of green micas commonly adds bright green areas to the yellow units. Chloritised sections are pale to dark green. Although chlorite is the most common ferromagnesian mineral in the tuffs, it is rarely found in great abundance in the felsic and intermediate tuffs in the map area. Carbonate alteration is also common and locally intense. It partially to fully replaces fragments and crystals, forms small veinlets or partly replaces the ash matrix.

Heterolithic tuff sequences in the Sheraton Lake area have normal graded bedding, giving a top direction toward the south-east (Photo 3). This observation is in agreement with the younging direction given by the mudstone-siltstone units (see below).

Photo 3. Graded heterolithic tuff, Sheraton Lake zone, Sheraton Township. Golden Knight Resources Inc., diamond-drill hole # SKG-97-6, BQ core.

A felsic tuff breccia sample taken from drill core in the Cross Lake zone revealed an U/Pb zircon age of 2703.7 ± 1.4 Ma (Ayer et al. 1999a). This age falls into the range of other calc-alkaline felsic volcanic rocks along strike to the north-east in Currie Township (2706 ± 2 Ma; Corfu 1993) and to the south-west in Douglas Township (2703 ± 2 Ma; Corfu 1993). They are thus interpreted to be part of the Tisdale assemblage.

Crystal Tuff

There is a continuum between lapilli tuff and crystal tuff as all proportions of the two components have been observed. The crystal tuffs are mostly composed of plagioclase crystals and crystal fragments, local chloritic shards and a fine ash matrix (Photo 4). They display weak to very well developed bedding from which younging directions toward the south have been determined in the Sheraton Lake area. The crystal tuffs are pale grey to medium green in color. Local intense silicification gives the crystal tuff a very hard, green glassy appearance.

The size of the plagioclase crystals and fragments is between 1 mm and 5 mm. They are partly to completely transformed mostly to sericite but also to epidote or carbonates. Quartz overgrowths are locally present on the margins of the crystals. The matrix is recrystallised and composed of <0.05 mm polygonal quartz and chlorite with minor epidote. The chlorite wraps around the plagioclase crystals. After studying a large number of samples, Bowen (1998) concluded that the crystal tuffs present less euhedral crystals, less foliated matrix and a more common chlorite than sericite alteration compared to the porphyry dikes.

Photo 4. Crystal tuff, Sheraton Township. Cross Lake Minerals Ltd., diamond-drill hole # CLS-98-59, NQ core.

METASEDIMENTARY ROCKS

Graphitic mudstone, mudstone-siltstone and wacke intervals are locally interbedded with the volcaniclastic sequences in the Sheraton Lake, Cross Lake and Dougherty Lake area but were not observed anywhere within the tholeiitic mafic flow sequences. Chert was reported from diamond-drill core in the Cross Lake area but observations by the author suggest that intensely silicified intersections may have been misinterpreted.

Mudstone-Siltstone

Multiple intervals of medium gray to more commonly black mudstone-siltstone with various compositions are observed mostly in the Sheraton Lake and the Dougherty Lake areas. Locally developed normal grading consistently indicates younging to the south-east in the Sheraton Lake area. In the Dougherty Lake area, folding is responsible for the great variability of the grading in the sediments (Photo 5).

The black graphitic argillites of the Sheraton Lake area have strong electromagnetic conductivity and are thus clearly seen as linear arrays of anomalies on the airborne EM survey. These argillites also contain variable amounts of pyrite or pyrrhotite in globular shape or disseminated and common quartz-carbonate veins with sphalerite, chalcopyrite and galena.

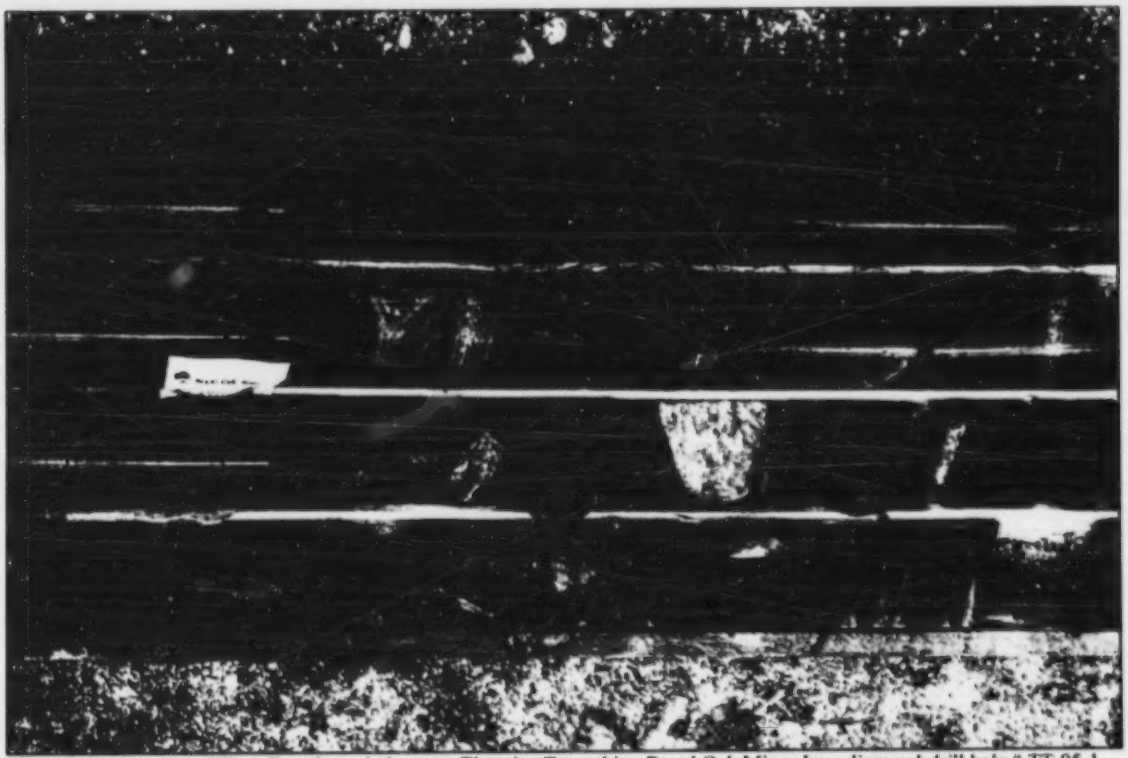

Photo 5. Folding in argillites, Dougherty Lake area, Timmins Township. Royal Oak Mines Inc., diamond-drill hole # TT-95-1, BQ core.

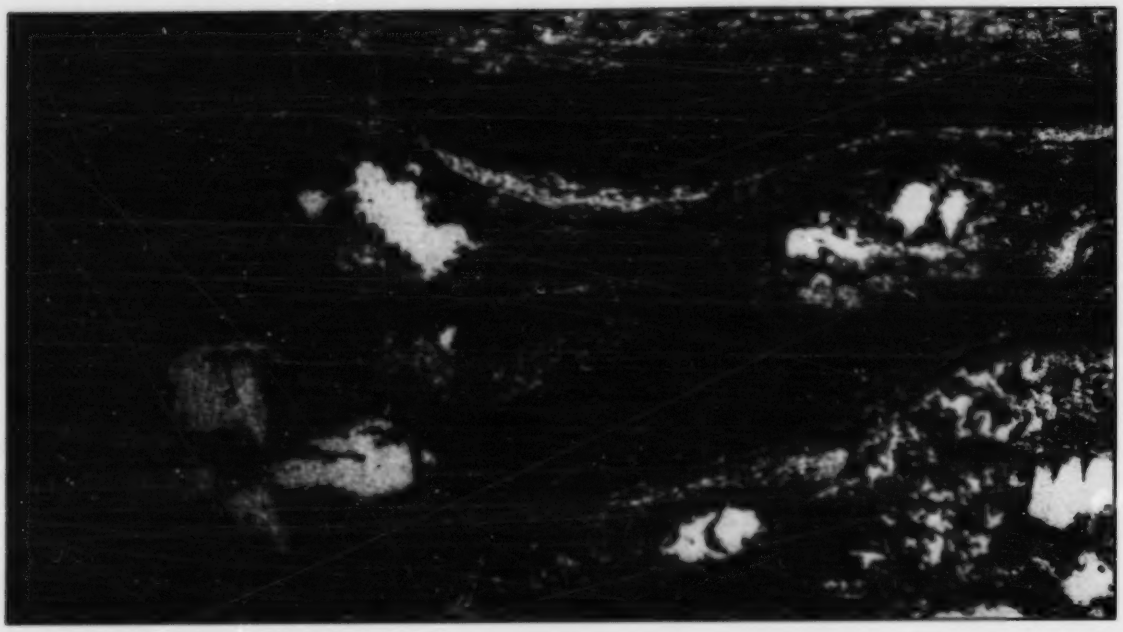

Photo 6. Photomicrograph of andalusite porphyroblasts in an argillite, Timmins Township. Width is approximately 6 mm.

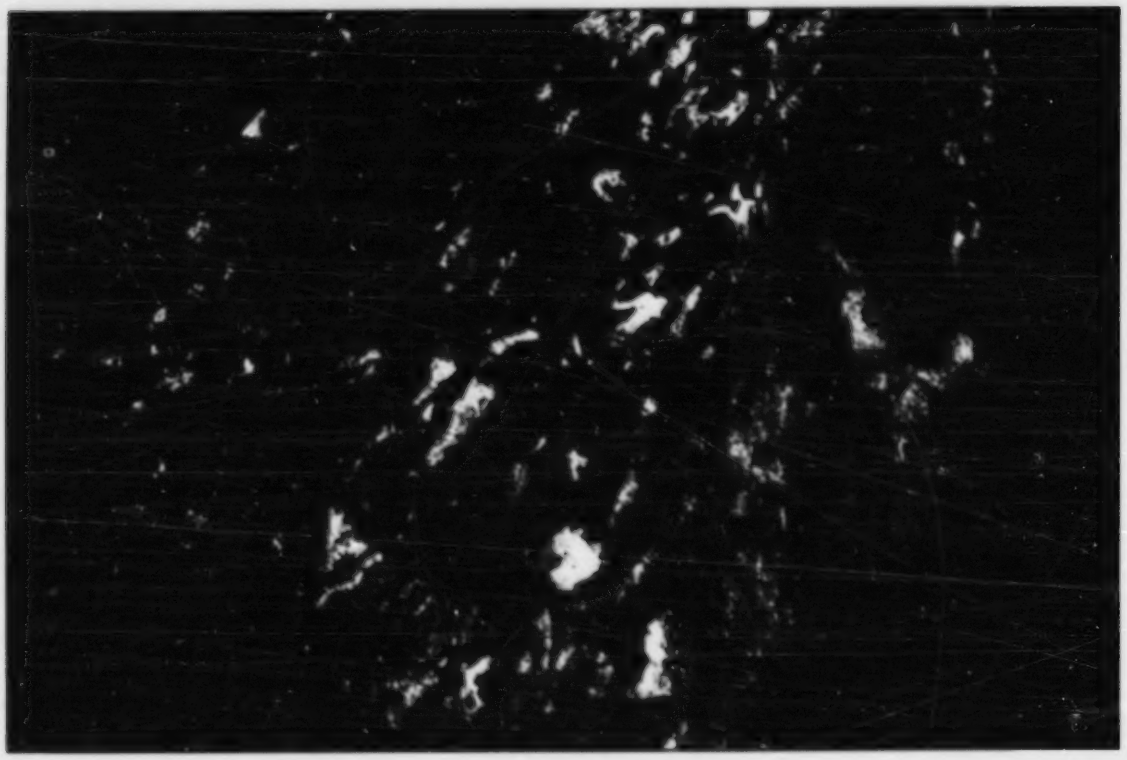

Photo 7. Polymictic conglomerate (left) and sandstone (right), Michie Township.

Andalusite porphyroblastic argillite is the most common sedimentary unit in the Dougherty Lake area. The unit has not been observed in outcrops and was recognised only in the easternmost diamond-drill holes. Although the andalusite is almost completely to completely pseudomorphed by damourite (fine specks of micaceous products), the diagnostic tabular shape with a black cross of the chiastolite variety are still present (Photo 6). The relatively small thickness of these units with the folding and possible displacement along faults makes the correlation difficult from adjacent drill-holes. It is the reason why these units were not shown separately on the map.

Conglomerate

A polymictic conglomeratic unit was observed within a confined area in south Timmins and north Michie townships (Figure 3). It is heterolithic with at least seven different kinds of pebbles, which in order of abundance are: (1) dark green ultramafic volcanic rocks; (2) ophitic textured gabbros; (3) coarse grained pyroxenitic to gabbroic rocks; (4) felsic intrusive rocks (5) fine, gray metasediments; (6) epidotised felsic to intermediate volcanic rocks and (7) vein quartz. The pebbles are well rounded, although the softer ones are highly deformed (Photo 7). The size of the pebbles is relatively homogeneous within the various components but may range between 1 to 10 cm from one outcrop to another.

The average grain size of the matrix is approximately 0.05 mm and it is composed of approximately 45% feldspar, 25% quartz, 30% tabular and acicular amphiboles and less than 1% epidote. Feldspars are partially altered to sericite.

Where observed, this unit commonly displays very intense deformation and possibly two episodes of folding (refolded folds). The relatively soft ultramafic pebbles, which are the most abundant components, are strongly flattened and wrapped around harder pebbles.

The unit is considered to possibly be equivalent to Timiskaming conglomerates given the presence of vein quartz however exposures are limited and primary structures indicative of alluvial-fluvial depositional setting were not observed. Therefore, no conclusions have been made on the origin of the conglomerate, as the contact relationships with the surrounding mafic volcanic rocks are not clear.

MAFIC AND ULTRAMAFIC INTRUSIVE ROCKS

Metagabbros

Metagabbros of various origins are present throughout the map area. They can be separated into four major categories: 1) synvolcanic dykes and sills intruded in the mafic volcanic rocks; 2) large, coarse-grained and quartz-bearing gabbro dikes; 3) coarse-grained silica-saturated gabbro at the margin of the Bradley Lake syenite pluton and 4) late fine-grained gabbroic dikes intruding all volcanic sequences.

The synvolcanic dikes and sills are often difficult to distinguish from the recrystallised mafic flows or the center of thicker massive flows since they don't have well-developed chilled margins. They are compositionally similar to the volcanic rocks they intrude.

Large coarse-grained gabbro dikes are located in southern Sheraton and northern Timmins townships (Photo 8). They are mostly very well preserved but are locally cut by deformation zones that transformed them into chlorite-schist. Centimetre-scale ultramafic patches and pegmatitic phases have been observed, but the average mineralogical composition and texture is generally homogeneous. The average size of the

minerals is approximately 2 mm and they consist of plagioclase, actinolite, magnetite, quartz and minor pyrite. Plagioclase is largely altered to epidote, carbonates and minor sericite. Traces of chlorite are also present. Quartz forms bluish eyes up to 4 mm in size.

Photo 8. Coarse-grained gabbro, Timmins Township.

The gabbro observed at the margin of the syenite pluton is macroscopically very similar to the previously described unit, but the proportion of magnetite is much lower and it does not contain quartz eyes. Relatively large crystals of apatite (up to 0.5 mm) are also present in this gabbro. Similar crystals have also been observed in the syenite but seem to be absent in the other gabbros. Primary layering was observed on only one outcrop. The study of a thin section reveals that the feldspars have strongly suffered kaolinitisation and now have a brownish foggy appearance. The larger 2-3 mm amphiboles (actinolite and possibly hornblende) have partly recrystallised into multiple smaller crystals of about 0.5 mm. Chlorite patches were locally observed at the margins of the large hornblende crystals.

Two samples of fine-grained gabbroic dikes intruding the variolitic-pillowed flows of the Kinojevis and the calc-alkaline flows of the Tisdale assemblage were collected in Timmins Township. They both present similar texture and mineralogy. They are composed mostly of fine acicular actinolite of 0.2 mm, epidote, sericitised plagioclase and traces of quartz and carbonates. Schistosity is well developed in both samples and the dike intruding the Tisdale assemblage centered on a small shear zone with an orientation of 345°. Beside the fact that they are obviously synchronous or younger than the Tisdale volcanic rocks and synchronous or older than the main north-north-west deformation (see Structure, this report), not much is known about the nature and origin of these dikes.

The Nordica Intrusion

The Nordica intrusion is a mafic and ultramafic layered intrusion located at the south-west margin of the Bradley Lake granodioritic pluton in northern Nordica Township. Trenches excavated by Band-Ore Resources Limited revealed several distinct lithologies in this intrusion.

The most abundant unit exposed consists of troctolite, which is either coarse-grained or pegmatitic (Photo 9). It is locally intruded by very coarse hornblendite. A cumulate olivine gabbronorite located on the west side of the exposure is interpreted to represent the basal portion of the intrusion. A small chromitite layer is also present within the gabbronorite portion of the exposed area of the intrusion. The cumulate texture of the troctolite and olivine gabbronorite is reasonably well preserved but the primary mineralogy is completely transformed.

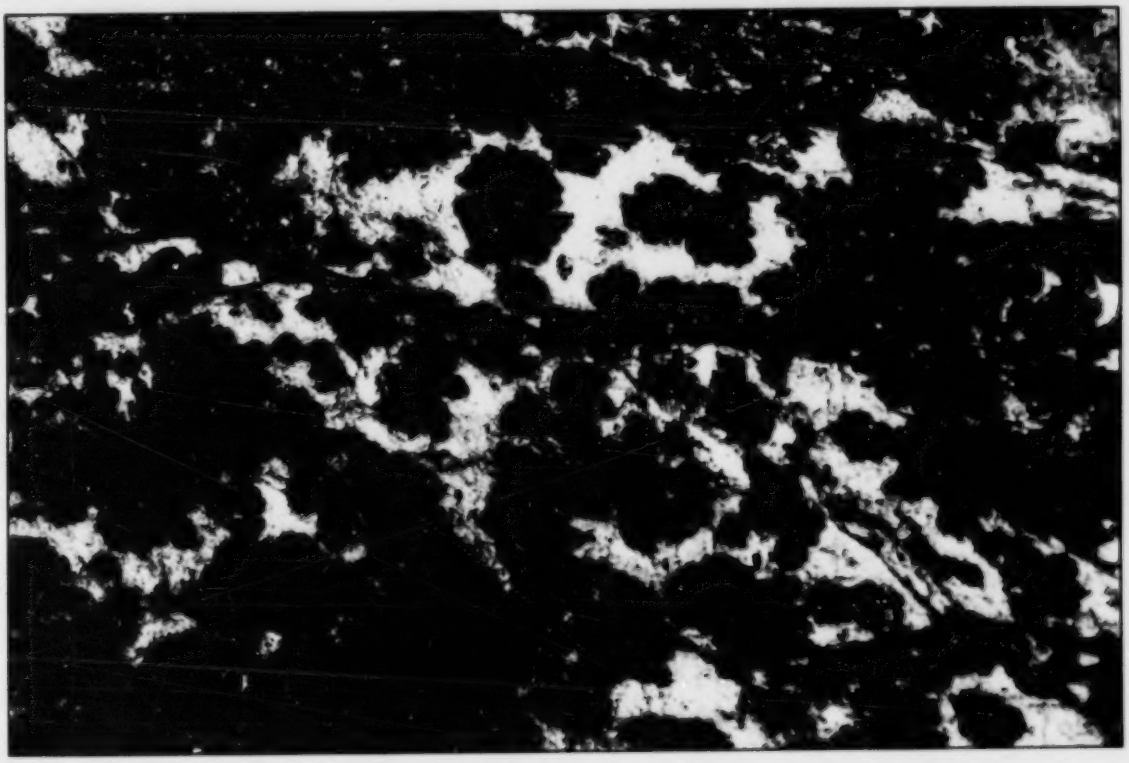

Photo 9. Troctolite from the Nordica intrusion, Nordica Township.

The troctolite is coarse-grained with a well-preserved cumulate texture. The original olivine and plagioclase are now completely transformed into amphiboles (probably tremolite), talc and argillaceous minerals. Layering is still locally recognisable (Photo 10) although an intense tectonic foliation intersecting the primary fabric at a high angle seems to have overprinted much of it.

Abundant pegmatitic units are interlayered with the previously described troctolites. Although the size of the plagioclase and mafic minerals is much larger, they are chemically similar to the troctolites. Some of the elevated platinum-group elements values reported by Band-Ore Resources Limited come from these units.

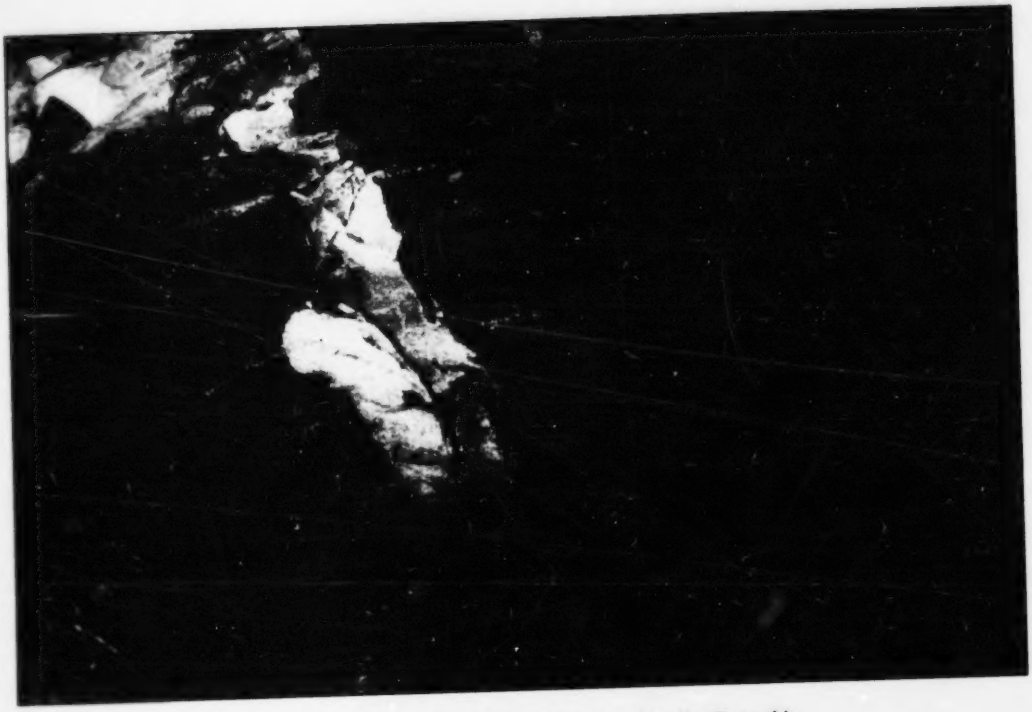

Photo 10. Magmatic layering in the troctolites of the Nordica intrusion, Nordica Township.

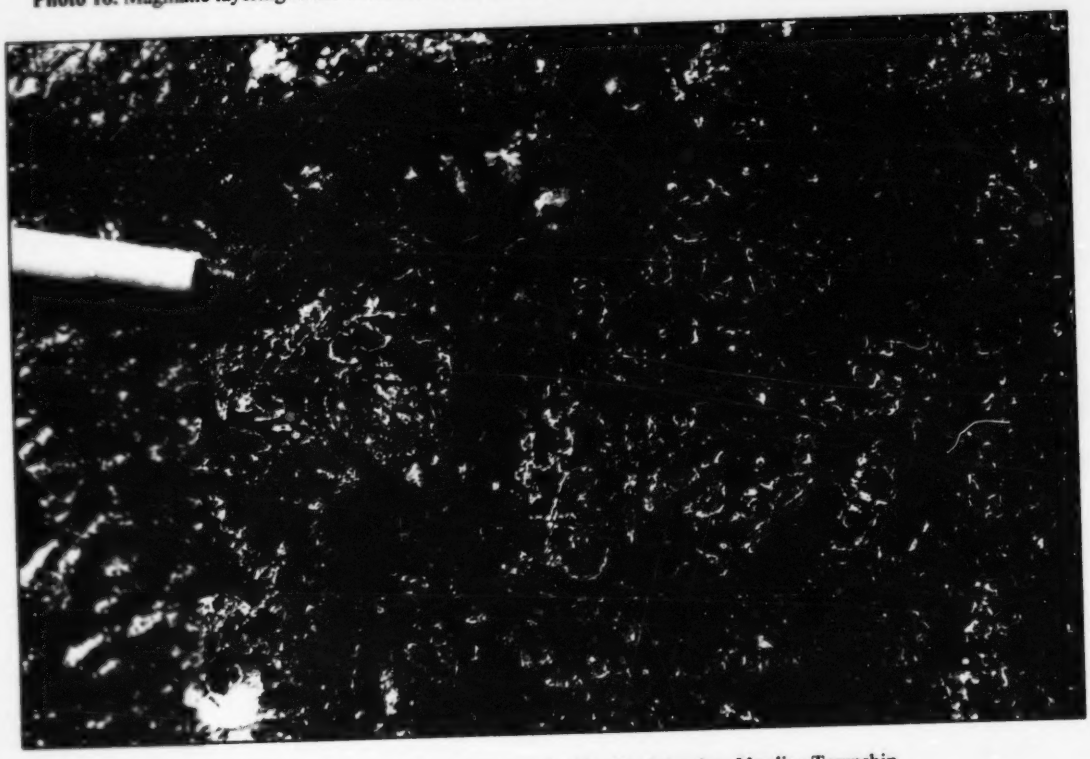

Photo 11. Cumulate texture in an olivine gabbronorite from the Nordica intrusion, Nordica Township.

An olivine-gabbronorite unit is also present in the trenches but no direct contact relationship with the other units has been observed. The cumulate texture is relatively well preserved but the original mineralogy is completely destroyed (Photo 11). It is mostly composed of approximately 5 mm cumulate crystals with amoeboid shapes that were olivine originally but are now transformed mostly into tremolite or talc. Oikocrysts of clinopyroxenes over 3 cm in size with small (<0.5 mm) inclusions of magnetite have crystallized around the accumulated crystals. This unit is thus very strongly magnetic. It also locally contains a small amount (1-3%) of sulfide minerals, possibly of cumulate origin.

Very coarse-grained hornblendite locally intrudes the troctolites (Photo 12). The amphibole crystals are between 1 cm and 3 cm and are locally recrystallised into multiple smaller grains <0.2 mm in size. Biotite and chlorite are also present. The hornblendites locally contain up to 8% sulphides, which gives a rusty look to the rock. Coarse olivine and garnet grains (5 mm) were also observed in the outcrop but they seem to be an uncommon feature. They are more likely to be related to metamorphism than to be of magmatic origin.

The thickness of the chromitite unit observed in the outcrop varies from 1 m to less than 3 m. It is massive with a dark gray to brownish color and is composed of over 50% chromite (Photo 13). The chromite crystals are polygonal and homogeneous in size (0.2 to 0.5 mm in diameter). The other minerals in this unit, in order of abundance, are phlogopite, orthopyroxene and clinopyroxene.

This mafic-ultramafic suite is intrusive into the volcanic rocks of the Kinojevis assemblage and is clearly cut by the granodiorites of the Watabeag batholith. Its timing is hence well constrained between the two events.

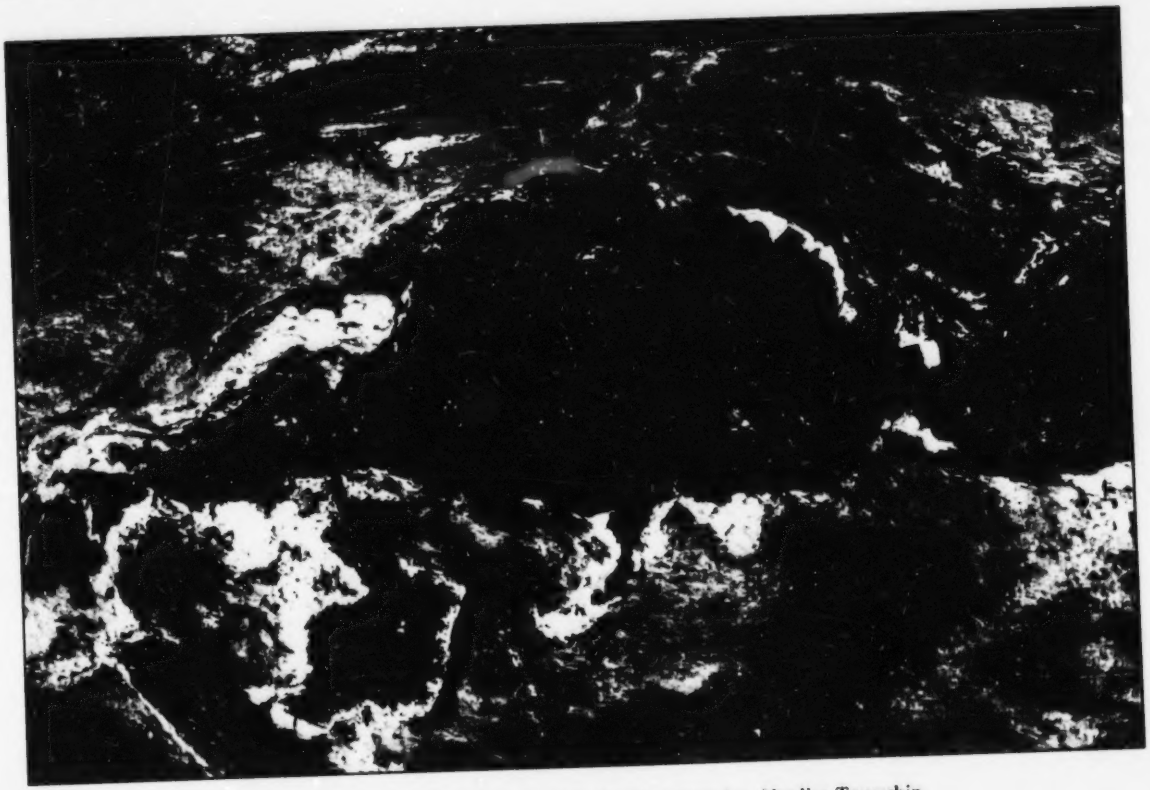

Photo 12. Very coarse amphibolite intruding the troctolites of the Nordica intrusion, Nordica Township.

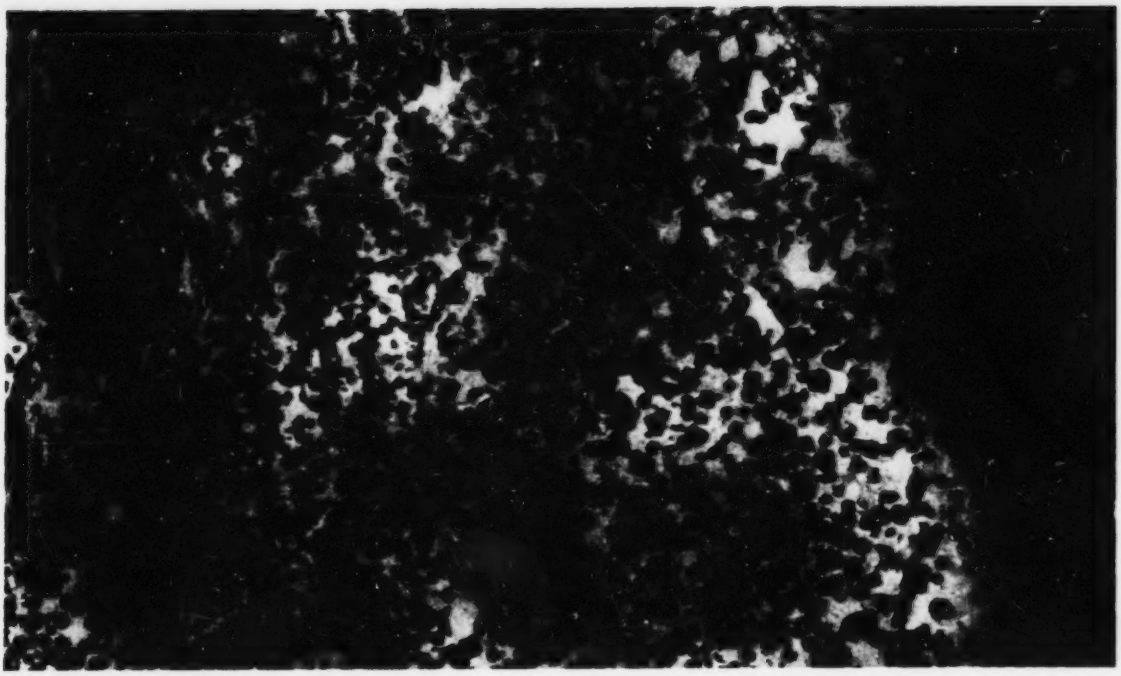

Photo 13. Thin section of a chromitite from the Nordica intrusion, Nordica Township. Width is approximately 1.4 cm.

INTERMEDIATE TO FELSIC INTRUSIVE ROCKS

Syenite

The only syenitic body in the map area is the Bradley Lake pluton, which occurs on the eastern boundary of Sheraton Township. Two different phases of syenite (Photo 14) have been observed just outside Sheraton township but Pyke (1976) also reports granodioritic phases in the south-eastern portion of the pluton.

The most abundant and oldest phase is a coarse-grained white unit with a subhedral granular texture. Pink hematisation occurs along fractures. Average size of the feldspars is around 2 mm. The mafic minerals are diopside, titanite and magnetite, together representing around 10% of the rock. Other trace mineralogical components are prismatic nepheline up to 0.7 mm and 0.3 mm zircons.

The second later phase, based on crosscutting relations, is pink with generally smaller grain size and a porphyritic texture. Phenocrysts are K-feldspar and smaller plagioclase with well-developed zoning. The phenocrysts range between less than 1 mm and up to 5 mm. The mafic minerals are smaller and less abundant than in the older phase and consist mostly of diopside. Minor epidote, which seems to be absent in the older phase was also observed. Titanite, magnetite and andradite are present but only in trace amounts.

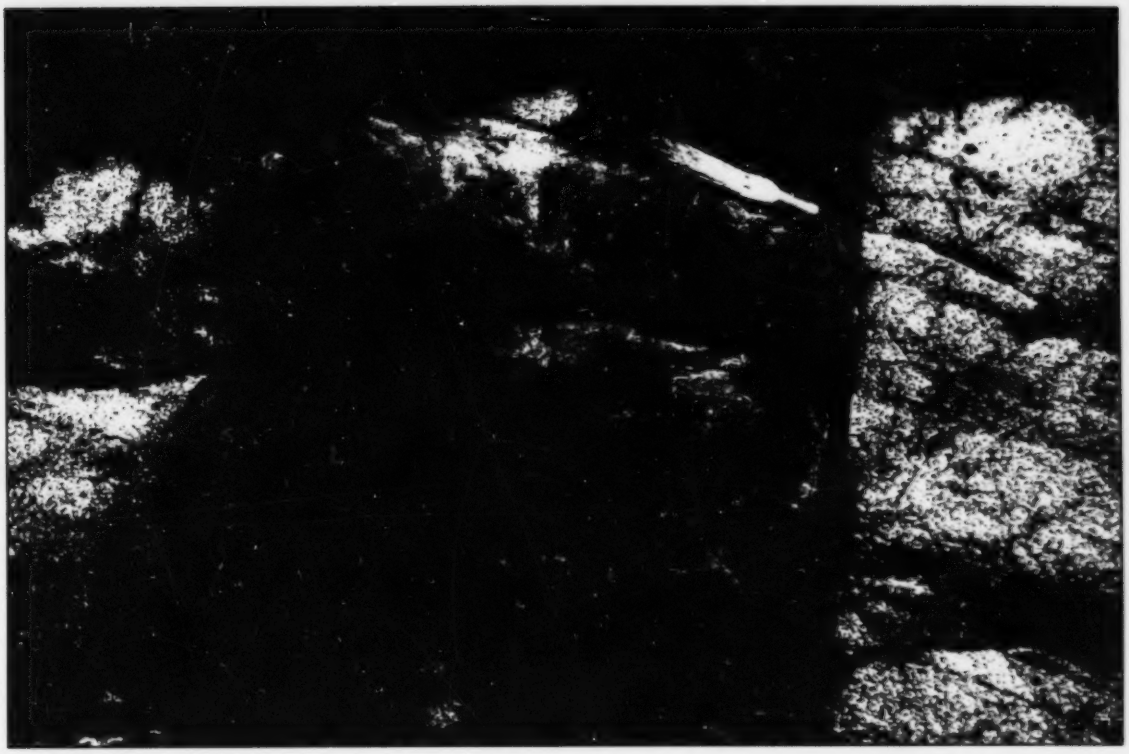

Photo 14. Two phases of the Bradley Lake syenite, Egan Township.

Granodiorite

Large granodiorite bodies surround the metavolcanic rocks. The Kasba Lake and the Watabeag Lake batholiths located in the east, center and south-east of the area are hornblende-granodiorite and the Blackstock batholith, which covers the south-west, is biotite bearing. A granodiorite sample collected from drill core at the Sheraton Lake zone contains both hornblende and biotite but this feature seems to be uncommon.

The hornblende granodiorite has a typical hypidiomorphic-granular texture formed by 60-65% plagioclase, 15-20% quartz, 15% K-feldspars, 5% mafic minerals and traces of titanite, apatite and zircon. The feldspars are tabular and between 1 and 2 mm in average. They are lightly to severely altered. Quartz is interstitial to the feldspars and mostly less than 1 mm in size. The most abundant mafic mineral is 0.5 to 0.7 mm tabular hornblende. Epidote and chlorite are also present and commonly are in lesser abundance although they can fully replace the hornblende locally.

The biotite bearing granodiorite are fairly similar to the hornblende bearing ones in respect to the abundance and size of the different minerals. The mafic minerals are < 0.5 mm dark green biotite, epidote and chlorite. This unit seems to be much less altered but the amount of samples studied from both granodiorites restricts generalisations. Frequent zonation in the plagioclase is underlined by weak sericite alteration. Also, well-developed myrmekites (intergrowth of plagioclase and vermicular quartz) are abundant.

A sample of the Kasba Lake granodiorite in the map area and a sample of the Watabeag batholith taken a few kilometres south of the area gave U-Pb ages of 2676±2Ma and 2681±3 Ma respectively (Frarey and Krogh 1986).

Porphyry Dikes

Feldspar and quartz-feldspar porphyritic dikes are present throughout the area in outcrop and in diamond-drill core. The dikes crosscut all volcanic units. Some of these dikes (feldspar porphyritic) may be related to the syenite pluton, as they are very similar in composition, alteration and deformation style. However, the quartz-feldspar porphyry dikes are too quartz-rich. foliated and highly altered and are more likely to be of a synvolcanic origin.

The plagioclase porphyry dikes contain between 20% and 30% phenocrysts. The matrix is composed of very fine quartz and plagioclase and up to about 0.5 mm wide amphiboles (hornblende ± actinolite), chlorite and epidote. The three mafic minerals are always present but the proportions between them vary from one dike to another from almost exclusively chlorite and epidote to 95% hornblende. This characteristic represents variation in the degree of metamorphism from middle greenschist to upper greenschist or amphibolite facies.

In the quartz and plagioclase porphyries, single crystals and agglomerations of crystals of both minerals are present. The size of the crystals and agglomerates varies approximately between 2 and 7 mm and constitute over 50% of the rock, with the plagioclase generally bigger. Very fine quartz grains and amphibole needles form the matrix. The plagioclase phenocrysts and the matrix are partly sericitised and the amphibole needles have chloritised cores and sericitised edges. Carbonates are present as 0.2 mm wide veinlets and very locally replace parts of the plagioclase phenocrysts.

Diabase Dikes

Members of two diabase dike swarms occur in the map area. They are the north-west-trending Matachewan dikes of Paleoproterozoic age and the east-north-east-trending Abitibi dikes of Mesoproterozoic age (Osmani 1991). They intrude all volcanic and plutonic rocks of the area, as they are younger in age. Their relatively high magnetite content (up to 15%) makes them traceable on aeromagnetic surveys. The abundance of dikes reported on the map is directly proportional to the resolution of the aeromagnetic survey available for the different sectors of the area and does not necessarily reflect their actual proportions.

The members of the Matachewan diabase swarm are the most common. Heaman (1988) gives a U-Pb age of 2454±2 Ma. The dikes have variable widths from a few meters and up to about 150 m. Their brown-orange colour on weathered surface is characteristic and makes them easy to recognise. They are mostly composed of plagioclase, clinopyroxene, magnetite and quartz, which minerals form an ophitic texture. The grain size varies from aphanitic on the borders (chilled margins) to very coarse in the center of the larger dikes. The most diagnostic feature of the Matachewan diabase dikes is the very common beige to pale green plagioclase clusters that give them a glomerophyritic texture. The clusters are most commonly between 2 cm and 3 cm but can reach up to 10 cm. These dikes are mostly unaltered and undeformed.

A few members of the Abitibi dike swarm cross cut all other rocks including the Matachewan dikes. The age given for this swarm is 1140.6±2 Ma (Great Abitibi Dike; Krogh et al. 1987). They are

commonly larger, reaching up to 250 m in width. The mineralogical composition observed in the map area consists mostly of plagioclase, alkali feldspar, clinopyroxene and magnetite but olivine is a commonly reported mineral of this dike swarm. As the Matachewan dikes, the grain size varies greatly from the margin to the centre of the dikes. They are also undeformed and generally unaltered although small epidotised and carbonatised sections have been observed in core.

Quaternary Formations

A map of Quaternary geology by Richard and McClenaghan (1984) covers all the area with the exception of the southern half of Michie and Nordica townships.

Pleistocene till deposits of the Matheson Formation and overlying glaciolacustrine deepwater and shallow-water Barlow-Ojibway Formation cover a large proportion of the Watabeag area. The Matheson Formation can be described as medium to very dense sandy silt, pebbly to cobbly. The Ojibway Formation is composed of fine to coarse-grained sand and massive to varved silt and clay. Toward the south, glaciofluvial deposits made of silty fine-grained sand to pebble gravel become more abundant.

The major north-west-trending Kettle Lakes and north-east-trending Watabeag eskers both cross the map area. They are composed of gravelly sand, pebble-boulder gravel and minor silt and sandy till.

Recent deposits such as peat and muck, clayey silt to pebbly gravel and fine to medium grained sand representing respectively organic deposits, alluvium and eolian deposits are also present in minor abundance.

Metamorphism

Most of the volcano-sedimentary rocks of the Abitibi subprovince have undergone regional metamorphism ranging from sub-greenschist to greenschist facies (Jolly 1974, 1977, 1978, 1980; Powell et al. 1990). Amphibolite facies contact metamorphism was locally achieved around the large granodiorite bodies and alkalic plutons.

The mineralogical assemblage of actinolite, plagioclase, quartz, epidote and occasional chlorite is the most common and is representative of the lower greenschist metamorphic facies.

Because the map area is surrounded by large granodiorite batholiths, upper greenschist to amphibolite metamorphic facies is common. Diagnostic of these higher metamorphic facies in the area is the mineral assemblage hornblende, plagioclase, quartz and epidote with very little or no chlorite. Local presence of garnet in portions of the mafic rocks also indicates elevated metamorphic conditions. In basic rocks, the mineral assemblage by itself is often not enough to clearly separate the upper greenschist from the amphibolite facies. More advanced analytical work would be required.

Assimilation textures in the volcanic rocks near large felsic dikes have been recognised in south-east Sheraton Township. Also, partial melting was observed in a slab of mafic volcanic rocks caught between the Watabeag granodiorite and the Nordica intrusion in Nordica Township (Photo 15). Felsic magma would have to be overheated to achieve partial melting of the mafic host. This may explain the intense recrystallisation of large portions of the volcanic rocks as a result of contact metamorphism by the granodiorite batholiths.

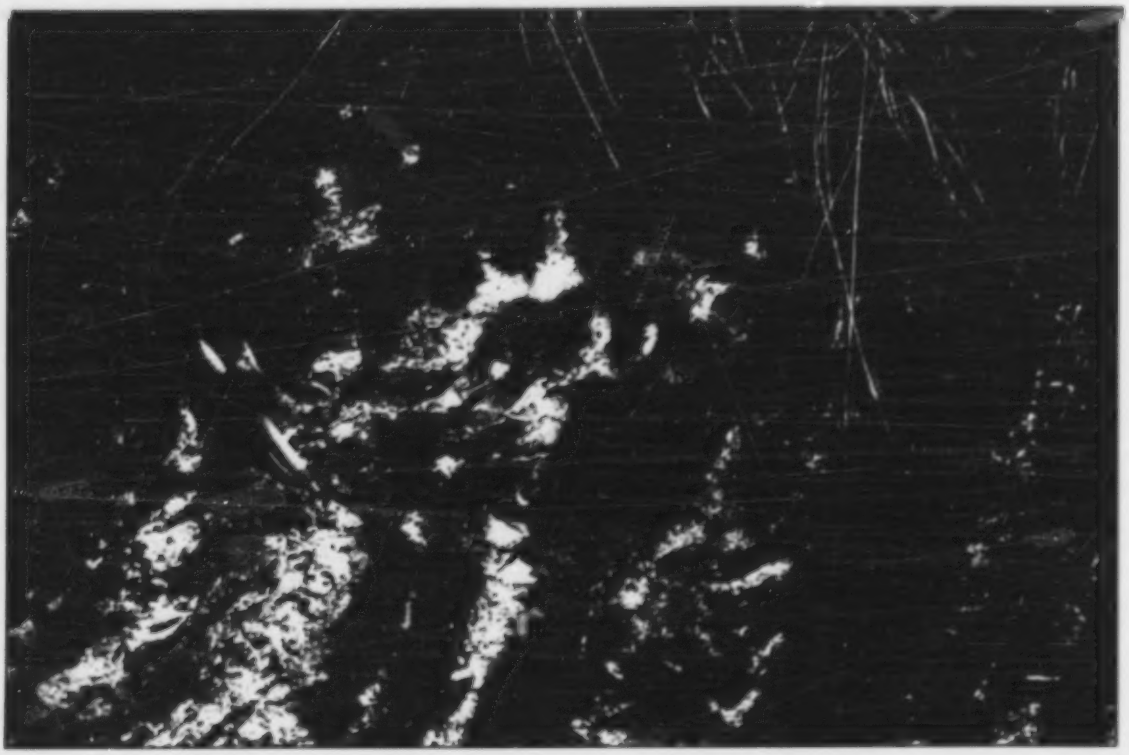

Photo 15. Partial melting in the mafic volcanic rocks of the Kinojevis assemblage, Nordica Township.

The presence of the andalusite porphyroblasts in the argillites implies low-pressure metamorphism. Low pressure is consistent with contact metamorphism. These argillites were observed exclusively in the eastern portion of the Dougherty Lake area.

Structure

Figure 4 is a sketch of the major structural components of the area. The reader is referred to Figures 2 and 3 for the location of the different areas mentioned in the following section.

Structural deformation in the area is generally very strong and expressed as penetrative schistosity, more focused shear zones, and folding. It is possible that the intense deformation zones are also the locus of intense silicification. These zones would then be preferentially preserved as outcrops. It would explain why almost all outcrops are so intensely deformed. It is also possible that the outcrops are representative of the area and the deformation is in fact very intense everywhere.

Deformation in the calc-alkaline units is highly variable, from moderately stretched pillows to schist of unrecognisable protolith. Sericite schist is host to most of the sulphide minerals in the Sheraton Lake and Cross Lake zones but also in the Dougherty Lake area, which was the focus of exploration by Royal Oak Mines Incorporated, International CanAlaska Resources Limited and East-West Resource Corporation. Shear sense was not determined in these units as most data comes from core.

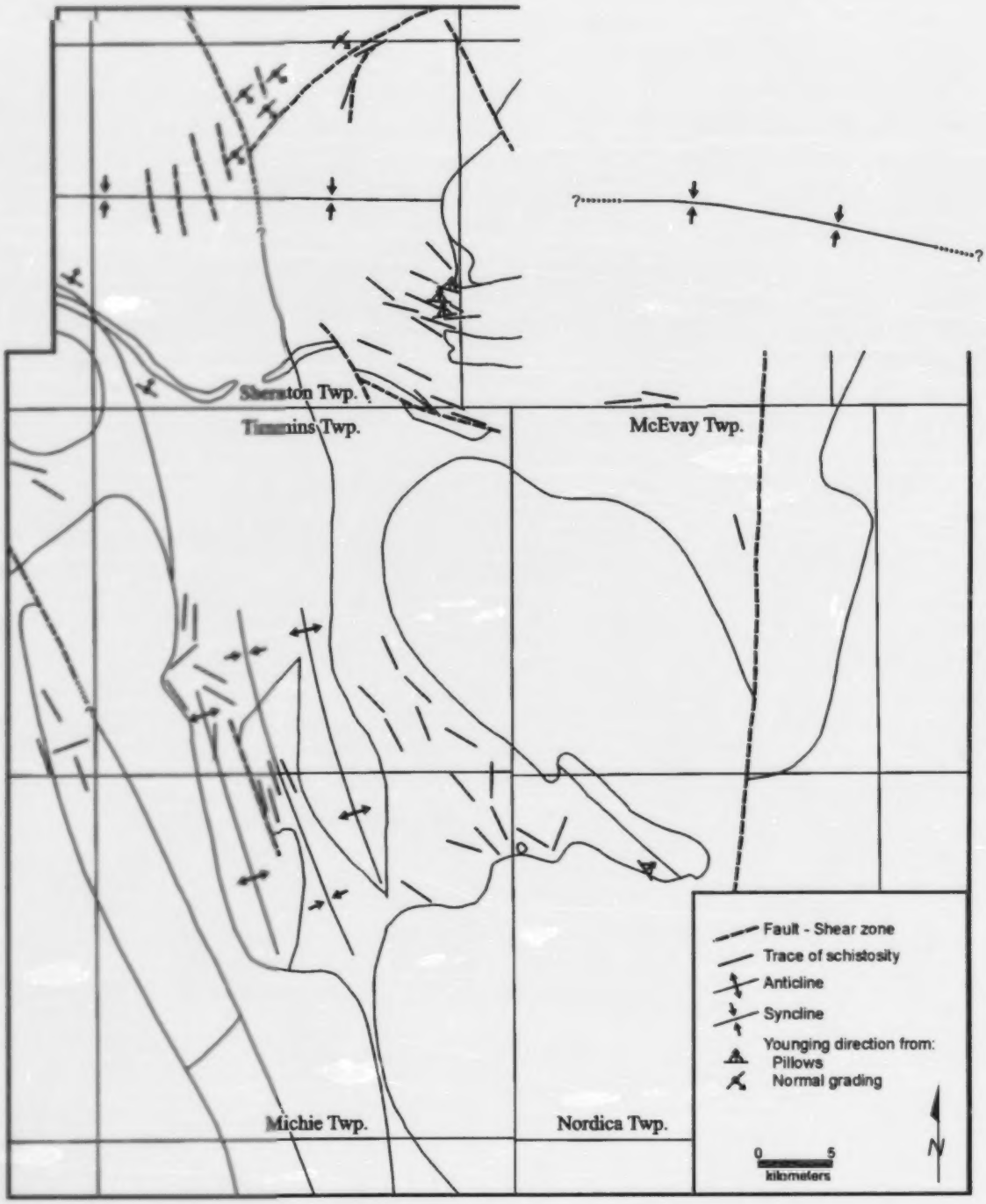

Figure 4. Major structural components of the Watabeag area.

Apart from rare well-preserved sectors, deformation is very intense all across the tholeiitic mafic volcanic rocks. Schistosity is locally developed to the level of forming chlorite schist in the mafic volcanic and intrusive rocks. Breccias are commonly strongly banded with highly stretched fragments in a silicified matrix. Very few top directions were determined, as most depositional features have been obscured by deformation.

The stratigraphic directions were determined by the shape of the pillows in locally less deformed pillowed flows. Normal grading in sediments (graded tuffs, conglomerates, mudstone-siltstone sequences) exclusively observed in core, were also used to interpret younging direction of the stratigraphy.

In the south-east corner of Sheraton Township, all pillow tops observed indicated younging toward the north or north-east. The same orientation was found in the recrystallised pillowed flows in Nordica Township. In the Sheraton Lake and Cross Lake zones, normal grading in tuff and tuffaceous sediments appeared to agree on a stratigraphic top toward the south-east. Although not entirely unequivocal, normal grading toward the north-east was interpreted in reworked tuff at the south-western corner of Sheraton Township.

The schistosity planes are most commonly underlined by the flattening or stretching of the tabular and acicular minerals like amphiboles and micas and by the beginning of segregation between the mafic and felsic minerals where deformation is more strongly developed. Micaceous alteration minerals tend to wrap around the other minerals to form well defined planar structures. Stretching lineations were locally observed and are formed by the alignment of the acicular amphiboles in the mafic pillowed flows. The varioles were also a good marker to measure lineation (where stretched) or to observe its absence (where flattened) in the mafic flows. Stretching of the fragments in pillow breccia form very well defined lineations, especially in the Dougherty Lake area where the linear fabric is locally more developed than any planar fabric.

The most commonly observed strike for the schistosity is north-north-west, with a subvertical dip. It is also the direction of major shear zones observed in Timmins and Michie townships. This schistosity doesn't seem to have accommodated a strong lateral component. Stretching lineation in the schistosity plane is often absent or weak. In strongly flattened units, originally sub-spherical markers like varioles have locally taken a saucer shape, which demonstrate a deformation style that may be close to coaxial. Boudinage and folding are well developed on both planes perpendicular to the shear plane, which also suggests flattening strain.

West-north-west to east-west trending schistosity moderately dipping toward north is also present in the area. Well-developed stretching lineation moderately to strongly dipping toward the north-north-east is locally related to the west-north-west schistosity.

In the Cross Lake and Sheraton Lake areas, up dip projection of the stratigraphic units from the core to the surface requires the presence of north-north-west trending faults in order to correlate units within the holes. It is possible that the Cross Lake and Sheraton Lake zones were originally continuous, but were sinistrally offset by one of these north-north-west trending faults. On a regional scale, these smaller faults are parallel to the Cross Lake Fault of Pyke (1976). This fault would be located at the contact between the Tisdale and the Kinojevis assemblages. In the map area, no direct surface expression of the fault has been observed and the contact is thereby assumed to be stratigraphic. It is probable that displacement has occurred along that contact or at least portions of it.

East-west trending faults at the border of a gabbroic dike on the Sheraton-Timmins township boundary locally transformed the rock into chloritic schist, suggesting that they were active at the time of intrusion or after.

The north-north-west schistosity seems to correspond with the contacts between the rocks of the Tisdale and those of the Kinojevis assemblages except to the north where it curves toward the east. From the shape of the contact between the two assemblages in the south, large-scale folds with sub vertical axial plane oriented approximately 340 degrees can be suspected (Figure 4). The nature of the rocks (thick piles of mafic flows and no sedimentary units) along with the lack of outcrop and the intensity of deformation in the few present make it very hard to recognise the original direction of stratigraphy. No direct observation of the relationships between stratigraphy and structure were made to confirm the presence of these folds.

All pillow tops observed in the mafic volcanic rocks of the southern part of Sheraton Township indicate younging to the north and north-east. From the north-south stratigraphy and tops facing toward the south in southern Currie Township as reported by Pyke (1976), a large-scale synclinorium more or less centered on the Bradley Lake Syenite is suspected (Figure 4). The stratigraphic top toward the south-east in the Sheraton Lake and Cross Lake zones and toward the north-east in the south-west corner of Sheraton Township are also consistent with the synclinorium. Furthermore, this synclinorium was diagnosed to the east of the map area. Graded bedding was also observed in the Dougherty Lake area but due to the presence of smaller-scale folds everywhere in the drill core sections (Photo 5) no top direction can safely be deduced.

Alteration

The rocks from the Tisdale assemblage and those from the Kinojevis assemblage have different alteration styles. As previously mentioned in the section on Structure of the present report, it is difficult to know if the level of structural deformation and alteration observed in outcrops is representative of the entire assemblages or if only intensely silicified areas are exposed.

The calc-alkaline rocks in the Cross Lake and Sheraton Lake areas are heavily altered and display a wide variety of alterations. Pure silicification or a combination of silicification and sericitisation seems to affect all the rocks. Carbonate alteration was also observed in core and is locally intense. Sections of core are also weakly to moderately chloritised.

Silicification affects all volcaniclastic units and locally results in a rock almost entirely replaced by quartz. Plagioclase crystals and volcanic shards are locally totally replaced by quartz. In general, silicification is variable in intensity but is almost always present and not restricted to specific compositional units or zones. Sphalerite + galena are commonly abundant in larger zones where silicification is intensely developed.

Sericite alteration is the second most common type in the Cross Lake area. Intense sericitisation commonly occurs in combination with strongly sheared units and forms yellow bands in the volcaniclastic rocks. Original textures in the rock are mostly destroyed and the banded look of highly sericitised sections was named "tiger striped" because of its appearance. Higher zinc intersections are generally related to this alteration.

In carbonatised sections of core, the texture of the rock is nicely preserved although all components are almost completely transformed. Carbonates fully replace the lapilli and part of the ash matrix and also

form small veinlets throughout the rock. A combination of sericite and carbonate alteration is very common but they both also occur separately.

Chloritic alteration is not strongly developed anywhere in the intermediate to felsic volcaniclastic units. The chlorite component of the tuff matrix locally gives it a greenish colour but is not necessarily a result of alteration.

Widespread silicification gives a pale gray to almost white colour to portions of the mafic flows of the Dougherty Lake area. Only the subtle pillow borders on these outcrops allows the interpretation of originally mafic flows. Locally, the flows and the volcaniclastic rocks have a dense network of quartz and sericite veins producing web-shaped patterns on weathered surfaces (Photo 16). Silica alteration clearly propagates outward from these veins, with preferential spreading along the schistosity planes (Photo 17).

Biotite alteration is also very common in the calc-alkaline mafic flows and breccias where it concentrates in the pillow selvages and the matrix of the breccias, giving the rocks alternating medium-green and purplish-gray bands in core. Garnet was also observed locally and seems to be associated with the biotite alteration (Photo 18).

Quartz and chlorite veins appear to be associated with hydrothermal brecciation as they form the matrix to the fragments (Photo 19). Quartz and epidote veins are also present in the calc-alkaline mafic flows, but they are not as widespread as in the tholeiitic units.

Intense silicification associated with quartz and quartz and epidote veins is characteristic of the tholeiitic mafic volcanic rocks. A partial to almost complete replacement of the matrix by quartz and epidote is common in flow breccias and pillow breccias. Where deformation is strong, these units take on a striped look from the dark green fragments and the pale beige bleached matrix. The quartz-epidote veins with local chlorite or carbonate are very abundant throughout the Kinojevis assemblage.

Photo 16. Web texture resulting from intense veining, Timmins Township.

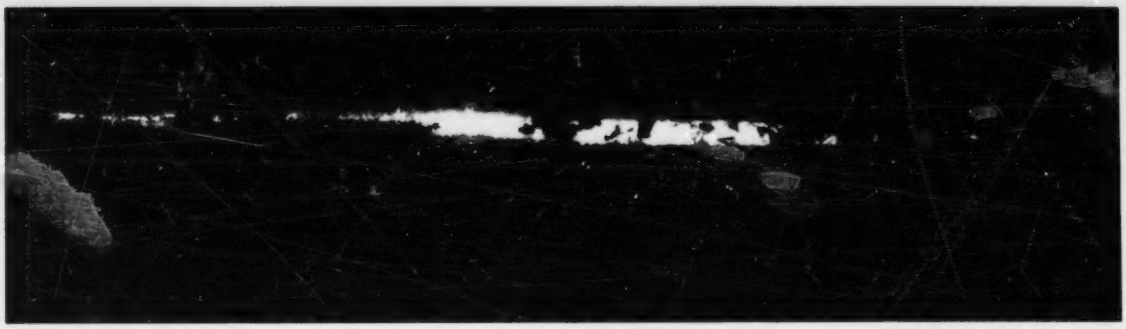

Photo 17. Propagation of alteration from a vein, Timmins Township. Royal Oak Mines Inc., diamond-drill hole # TT-96-04, BQ core.

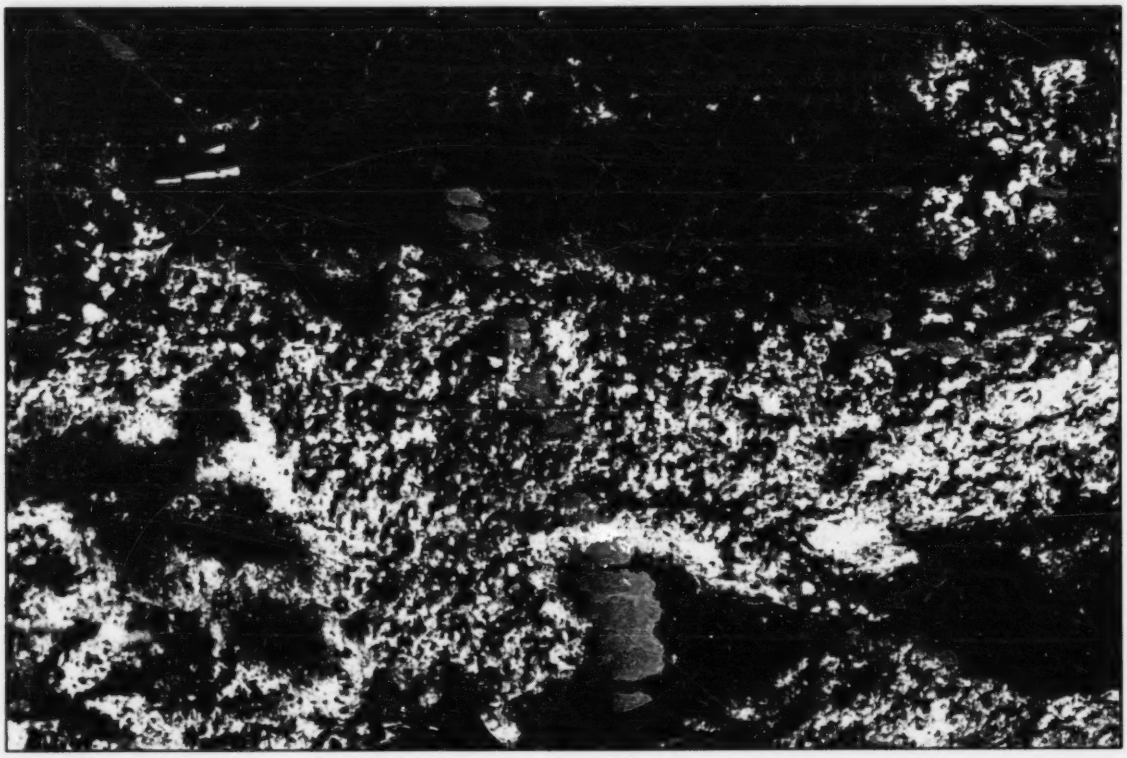

Photo 18. Biotite-garnet alteration in a pillow breccia, Timmins Township.

Photo 19. Hydrothermal breccia in core sample, Timmins Township. International CanAlaska Resources Ltd., diamond-drill hole # TT-99-03, NQ core.

Geochemistry

A total of 50 samples were analysed for major oxides and selected trace-elements in order to classify and characterise the various rock units and compare them to rocks of the assemblages in the surrounding area. The full spectrum of platinum-group elements (PGE), Re, Au and sulfur were also determined for 6 samples from the mafic-ultramafic Nordica intrusion in Nordica Township. This intrusion and other similar bodies have a high potential for Ni-Cu and/or PGE deposits. These analyses bring in important supplementary information about the petrogenesis of mafic-ultramafic intrusions and therefore their economic potential.

METHODOLOGY

All major oxides and trace elements except for PGE and Re were analysed at the Geoscience Laboratories, Sudbury. All samples were crushed with a small jaw-crusher with steel plates and pulverised by a 99.8% pure Al_2O_3 planetary ball mill. Major oxides and sulfur were determined by wavelength dispersive X-ray fluorescence. Trace elements were determined by inductively coupled plasma emission mass spectrometry (ICP-MS) or inductively coupled plasma atomic emission spectroscopy (ICP-AES).

PGE, Re and Au were analysed by instrumental neutron activation at Université du Québec à Chicoutimi after irradiation in the SLOWPOKE II reactor of École Polytechnique de Montréal following the method described by Bédard and Barnes (1990). The elements were previously concentrated into a nickel sulfide button following the method of Robert et al. (1971) with the modification from Lavoie (1992).

The results for the major oxides, S and trace elements for all samples are compiled in Appendix 1. PGE and Re for the Nordica intrusion samples are reported in Table 4.

CLASSIFICATION

Metavolcanic Rocks

The various samples of metavolcanic rocks were plotted on major element discrimination diagrams (Figure 5). All samples are well within the subalkaline field on the diagram of SiO_2 versus Na_2O+K_2O (Figure 5a). On Figure 5b, there is a clear separation between the volcanic rocks of the Upper Tisdale assemblage versus those of the Kinojevis assemblage between the calc-alkaline and tholeiitic field. However, not all samples plot in the expected field (Upper Tisdale samples (8) in the calc-alkaline field and Kinojevis samples (2) in the tholeiitic field). The relatively high mobility of the alkaline elements makes figures 5a and b very sensitive to alteration. The Jensen diagram (Figure 5c) which is supposed to be less sensitive to alteration still does not discriminate the two assemblages perfectly. Other factors can influence the position of the samples on this diagram, for example the presence of sulphides that will produce a displacement toward the $FeO + TiO_2$ apex or the accumulation or subtraction of mineral phases affecting Al_2O_3 (feldspar), MgO or FeO (olivine or pyroxene). Nevertheless, a large proportion of the samples from the Kinojevis assemblage is clustered in the high iron tholeiite field (HFT) and most samples from the Tisdale assemblage are positioned between andesite and basalt of calc-alkaline affinity.

The cobble from the conglomerate unit in Michie Township plots in the field of picritic komatiite (PK), which indicates that it is probably not equivalent to any known rock unit from the Tisdale or the Kinojevis assemblage in the studied area. This cobble represents the largest component of the polymictic conglomerate. Its actual source is not currently identified and may no longer exist as autochthonous volcanic rocks.

Figure 6 is a multiple-element diagram of the rare-earth elements (REE) normalised to chondrites for the metavolcanic rocks of the Watabeag area. Discrimination between tholeiitic and calc-alkaline affinities is better represented on this diagram because of the stability of the REE.

The samples from the Upper Tisdale assemblage form a light REE-enriched pattern typical of calc-alkaline rocks with $(La/Lu)_{CN}$ ratios between 4 and 14. With the exception of one sample, the REE abundance in the numerous samples varies only by a maximum factor of 3, indicating reasonably homogeneous composition throughout the assemblage. Because the clustered samples vary from pillowed basalt or andesite to rhyolitic breccias more fractionation in the patterns was expected. The isolated sample with the lowest abundance of REE is a mafic tuff breccia of the Sheraton Lake area.

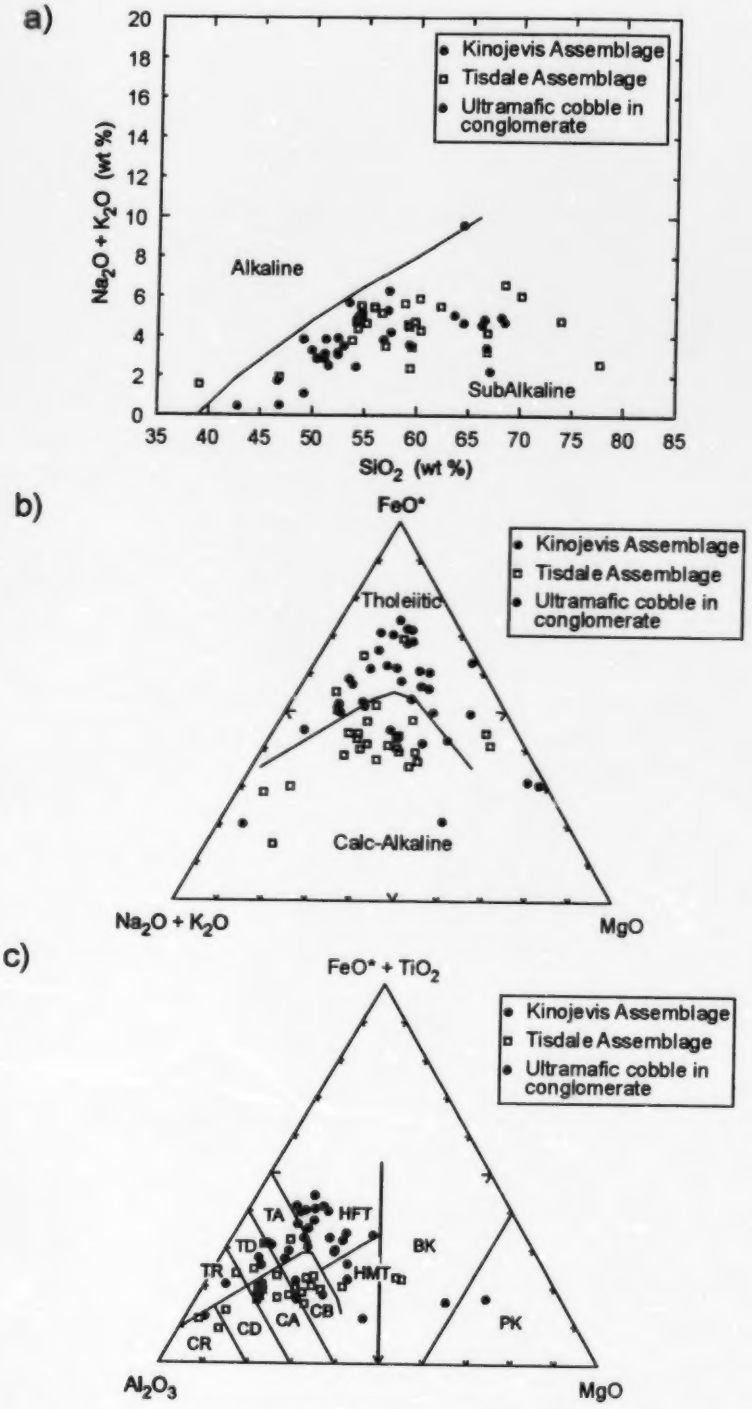

Figure 5. Major elements discrimination diagrams. a) Na_2O+K_2O versus SiO_2 (Irvine and Baragar 1971); b) AFM diagram (Irvine and Baragar 1971); c) Al_2O_3 - $FeO+TiO_2$ - MgO (Jensen 1976).

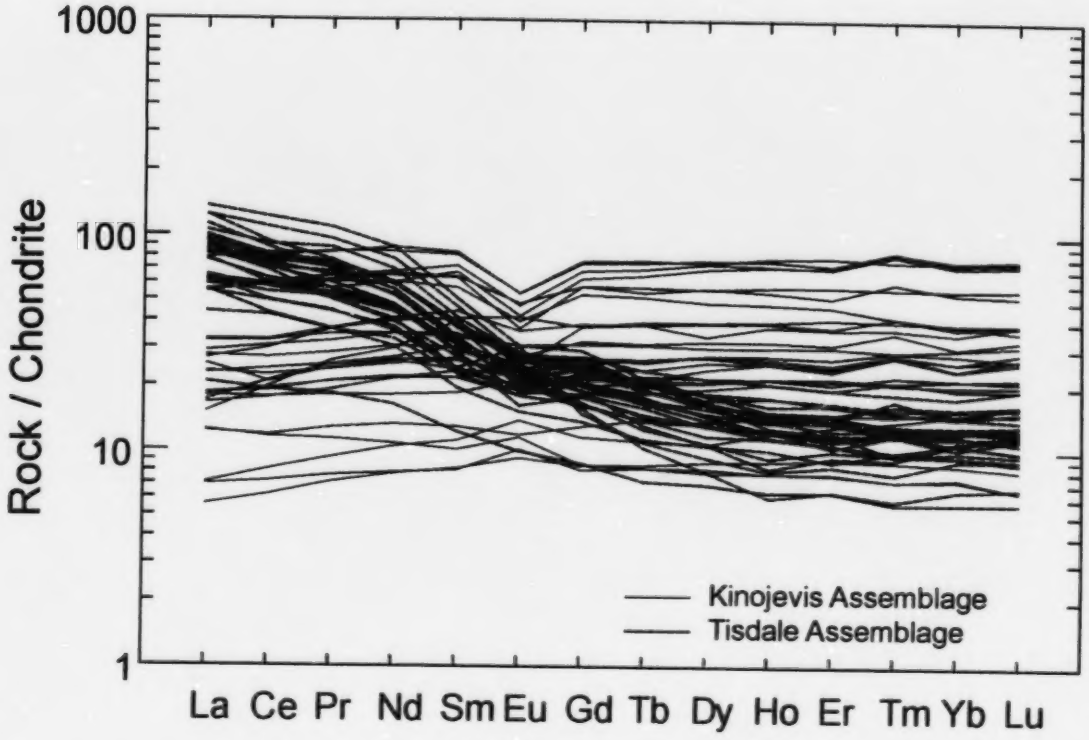

Figure 6. Chondrite normalised rare-earth elements plot of the metavolcanic rocks of the Watabeag area. Chondrite values from a compilation by McDonough and Sun (1995).

The samples from the Kinojevis assemblage have a very flat pattern with $(La/Lu)_{CN}$ ratios ranging between 0.7 and 2 which is representative of the tholeiitic affinity. The proportion of REE is highly variable, from 10 to 100 times the chondrites. This probably represents fractionation of minerals during evolution of the magma. The more variolitic units have higher proportions of REE. This feature is not particularly consistent with data reported by Fowler et al. (1987) where separate geochemical analysis of the varioles and their matrix gave higher REE concentrations in the matrix component. Analysis of the separate components was not performed for the present study.

Previous authors (Smith 1980; Capdevila et al. 1982 ; Fowler and Jensen 1989) have reported either no, or a slight negative Eu anomaly in the rocks of the Kinojevis assemblage. In the samples analysed for the present study, the more fractionated samples have negative anomalies and the REE-poor samples have positive well-defined Eu anomalies. Eu is incorporated into the plagioclase structure. The REE-poorer samples are probably the more mafic, less evolved phases and the positive Eu anomaly would represent plagioclase accumulation. On the other hand, the REE-richer samples with the negative Eu anomaly may result from a magma from which plagioclase has been removed (a more evolved phase). This feature is a strong argument in favour of a model implicating fractional crystallization for the formation of the Kinojevis assemblage. Partial melting of a variably depleted to undepleted mantle source (Jackson and Fyon 1991) cannot by itself explain the REE patterns. On the other hand, Fowler et al. (1987) interpreted the Eu depletion as resulting from superimposed alteration where Eu would be more mobile in the varioles. The rocks of the Kinojevis assemblage in the map area have a relatively high metamorphic grade and it is possible that it was not completely isochemical. If it is the case, the geochemical signature

of the petrogenetic history of the rocks is obscured. Because of the number of samples analysed and the coherence in the patterns, it seems more probable that the distribution of REE results from petrogenetic processes and not from alteration.

Mafic Intrusive Rocks

Geochemical results for REE from the different gabbroic dikes are presented on Figure 7. The patterns obtained discriminate reasonably well between the units described previously (see Description of units, this report). The syenite-related gabbro shows a regular pattern with a slight LREE enrichment. The coarse-grained gabbro sampled at the Sheraton-Timmins township boundary has a relatively flat pattern with a positive anomaly in Eu. This trend reveals its more tholeiitic affinity and possible genetic relationships with the volcanic rocks of the Kinojevis assemblage. The fine-grained gabbro samples have a highly evolved calc-alkaline trend and are thus not genetically related to the Kinojevis assemblage. The younger calc-alkaline volcanic rocks of the Blake River assemblage overlying the Kinojevis do not commonly have such a steep REE-pattern. Lamprophyre dikes in the Superior Province typically have very similar compositions (Wyman and Kerrich 1989) with a steep REE-pattern and low Ta, Nb and Ti (Appendix 1). However, the altered mineralogy is not diagnostic of such dikes.

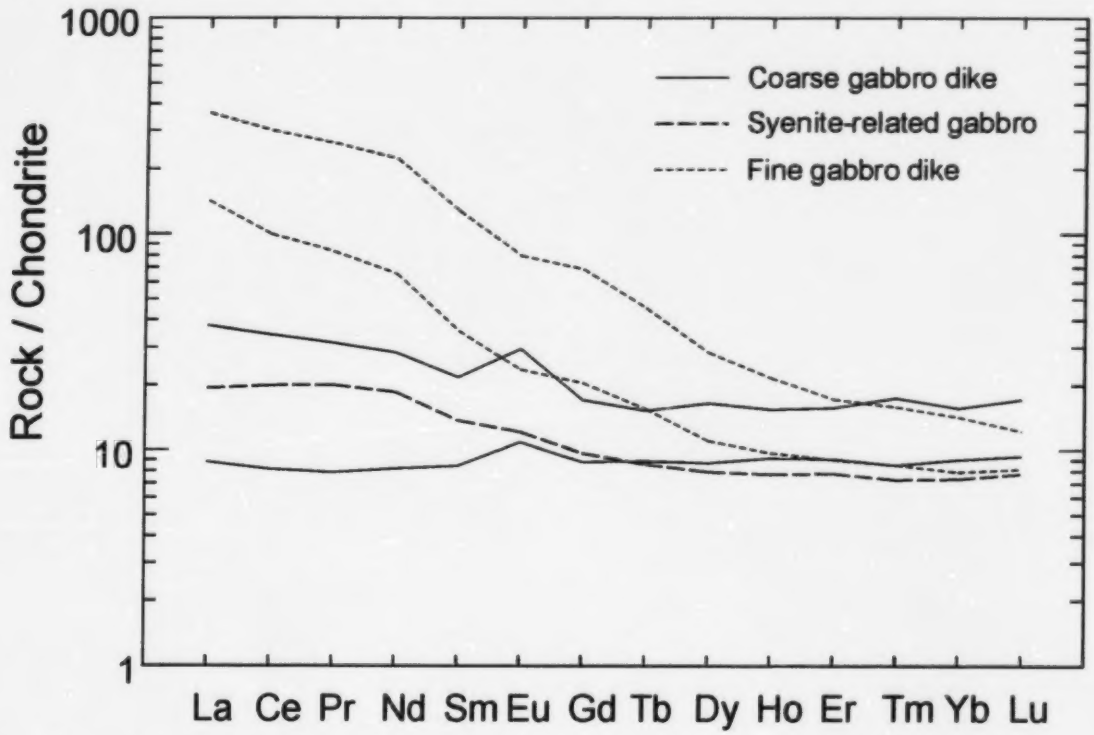

Figure 7. Chondrite normalised rare-earth elements plot of the mafic intrusive rocks in the Watabeag area. Chondrite values from a compilation by McDonough and Sun (1995).

THE NORDICA INTRUSION

As expressed in the Description of Units section of this report, the original mineralogy of the rocks at the Nordica intrusion is completely destroyed. For use of classification, CIPW norm calculation from major oxides geochemistry was used to estimate the initial proportions of olivine, orthopyroxene, clinopyroxene and plagioclase. The results are reported on triangular diagram for classification of mafic rocks (Figure 8). From this diagram, the samples can be separated into three groups: olivine gabbronorite, troctolites and plagioclase bearing ultramafic rocks (hornblendite).

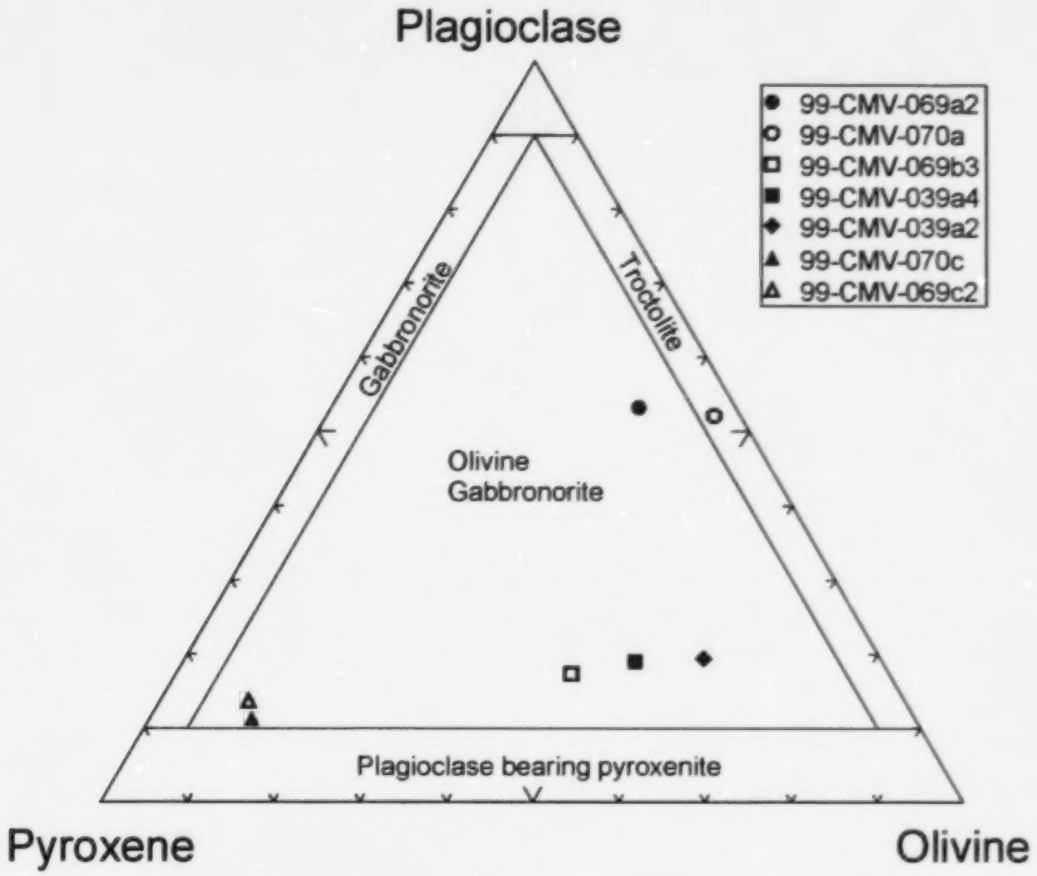

Figure 8. Classification diagram for the Nordica intrusion lithologies. From Streckeisen (1976).

The REE-plot for the Nordica intrusion samples is presented on Figure 9. The generally flat pattern of the different units reveals a tholeiitic affinity for the intrusion (mantle-derived source). In addition, the very low abundance of REE indicates that the parental magma to the suite was probably ultramafic in composition (high degree of partial melting). The three lithologies discriminated in the classification diagram are distinct and consistent in their REE-pattern except for sample 99-CMV-069b3 which was collected in a shear zone with intense biotite alteration. The major oxides are more affected by alteration than the REE and although the normative mineralogy classifies this sample in the olivine gabbronorite field, it is likely that the protolith was comparable to the hornblendite prior to alteration.

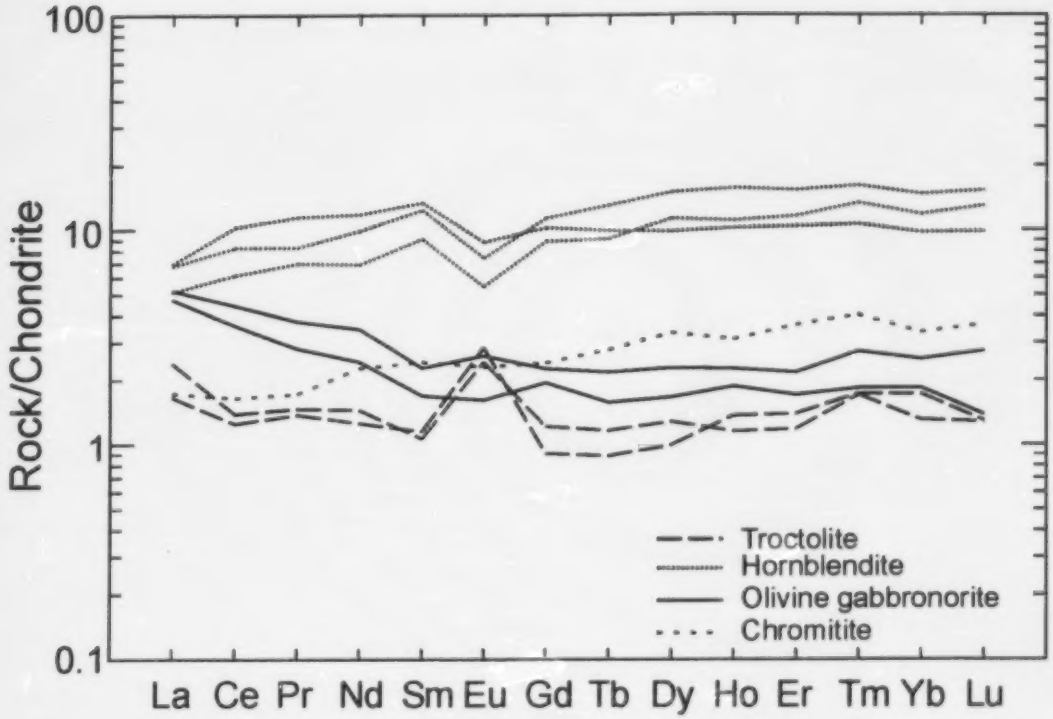

Figure 9. Chondrite normalised rare-earth elements patterns of the different lithologies from the Nordica intrusion, Nordica Township. Chondrite values from a compilation by McDonough and Sun (1995).

The troctolites have a strong positive Eu anomaly, confirming the plagioclase cumulate nature of the protolith. In contrast, the hornblendites have a negative anomaly in Eu that may result from plagioclase removal. They also are one order of magnitude higher in REE concentrations. The mirror-image pattern of these two units brings the possibility that the hornblendite was formed from a residual liquid after the generation of the troctolites from plagioclase (and probably olivine) accumulation. The absence of Eu anomaly in the olivine gabbronorites indicates that the plagioclase is not of cumulate nature and that this unit was not formed from a liquid that had already segregated plagioclase. It may more likely represent an earlier phase in the differentiation of the magma chamber where plagioclase liquidus has not been reached and olivine ± pyroxene are the only phases crystallising. Partition coefficient into olivine and pyroxene of the HREE are higher than those of the LREE. Hence, accumulation of the ferromagnesian minerals should have created enrichment in HREE. The pattern of the olivine gabbronorite shows the exact opposite. Assimilation of crustal material could be responsible for this enrichment.

Felsic Intrusive Rocks

The CIPW normative mineralogy of the felsic intrusive rocks is compiled on a classification diagram (Streckeisen 1976) on Figure 10. All albite was attributed to the alkali feldspar apex in the syenite samples because very little to no plagioclase was observed in these units. The plagioclase apex includes albite and anorthite for the other samples. It places most plutonic samples in the granodiorite field, porphyry dike samples in granodiorite, tonalite and diorite fields and finally, the Bradley Lake pluton samples in the feldspathoid-bearing syenite field. These classifications are consistent with the

macroscopic and microscopic observations made on the different felsic intrusive units, which indicate that the original composition, at least in the major elements has not been modified significantly.

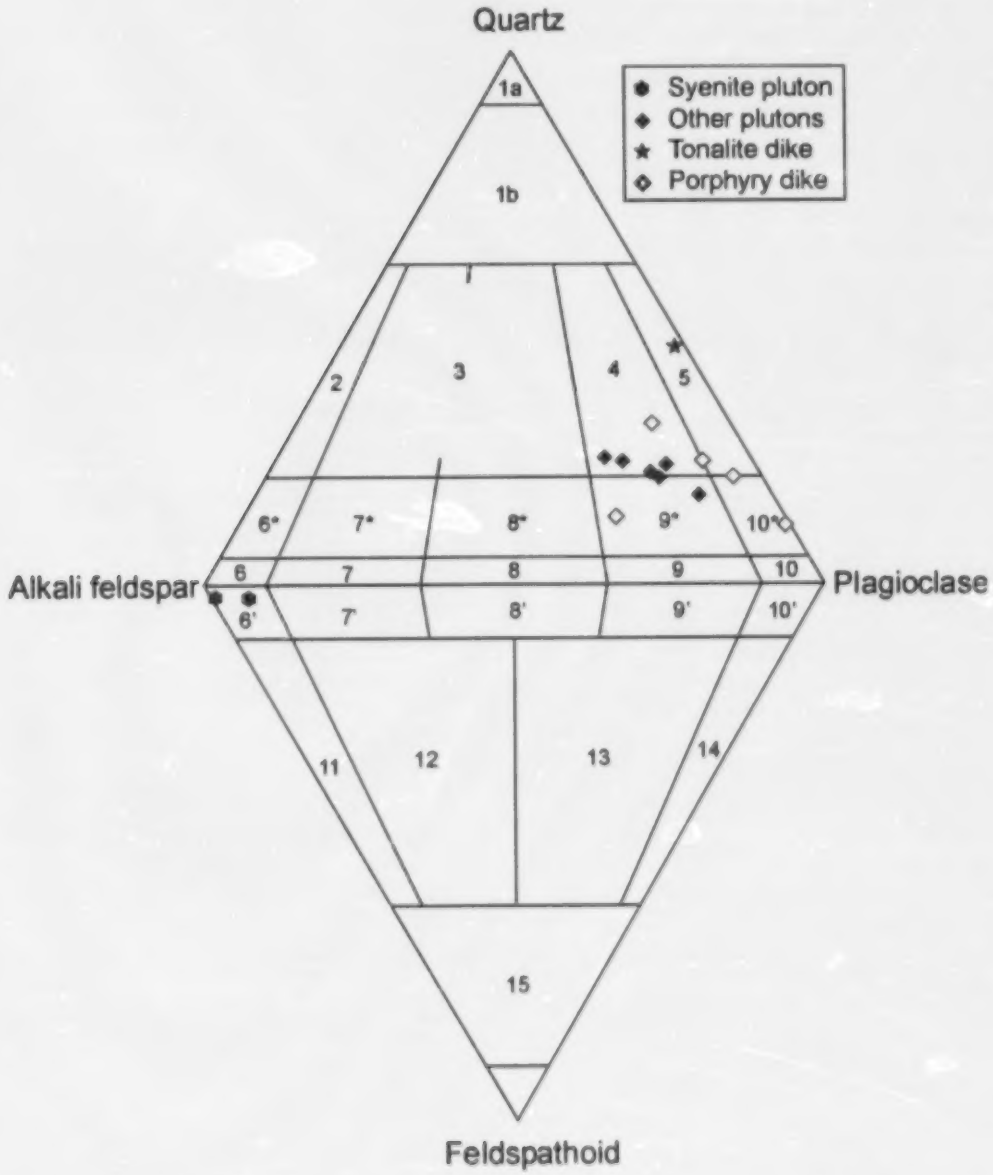

Figure 10. Classification of the felsic intrusive rocks of the Watabeag area. From Streckeisen (1976). Fields of interest are: 4=granodiorite; 5=tonalite; 9*=quartz monzodiorite; 10*=quartz diorite; 6'=feldspathoid-bearing alkali-feldspar syenite. See reference for other fields.

The various samples were reported on a REE-plot on Figure 11. The saw-tooth pattern on the HREE in the samples with the lowest concentrations in these elements is due to analytical problems and should

be disregarded for general interpretations. The trend with the LREE enriched compared to the HREE reveals the alkaline and calc-alkaline nature of the syenite, granodiorites and porphyry dikes. The porphyries intruding the calc-alkaline volcanic rocks in the Cross Lake area have a significantly steeper REE-pattern than their host (Figure 11). Also, the dikes seem to have similar trends whether they are intruded into the volcanic units from the Tisdale or the younger Kinojevis assemblages. These features indicate that they are probably not of synvolcanic origin. Since the porphyry dikes have many compositional similarities with the granodiorites and the syenites, they are likely to be comagmatic with one or more of the late Archean batholiths of the area.

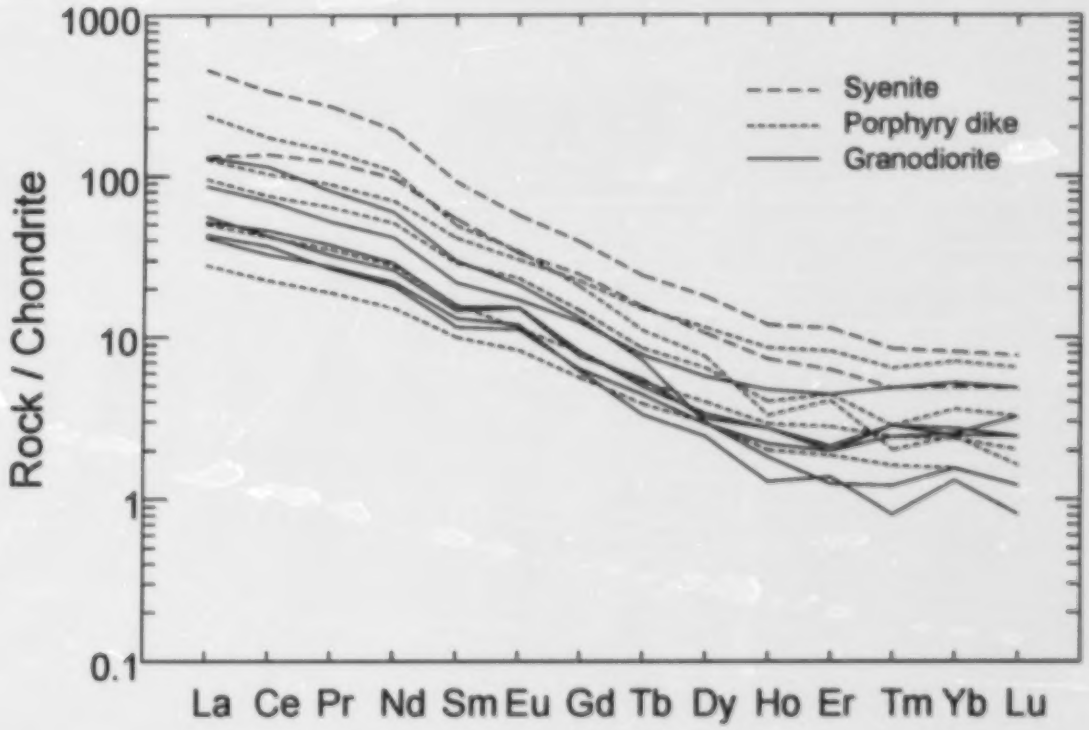

Figure 11. Chondrite normalised rare-earth element plot of the felsic intrusive rocks of the Watabeag area. Chondrite values from a compilation by McDonough and Sun (1995).

Figure 12 is a histogram displaying the relationship of Al_2O_3 to K_2O, Na_2O and K_2O to discriminate the nature of the source of the different felsic intrusive rocks. The two syenite samples have a well-defined metaluminous composition, which is concordant with their mineralogical composition (hornblende bearing) and a mantle-derived source of the suite (Shirey and Hanson 1984). The sample from the Blackstock granodiorite indicates a peraluminous composition, which is again consistent with the presence of biotite. A model of fractionation of parental monzodioritic magma (Stern and Hanson 1991) is preferred for the Abitibi granodiorite suite by Sutcliffe et al. (1993). All samples from the Watabeag and Kasba Lake hornblende-granodiorites have a metaluminous composition except for sample 99-CMV-038a, which has a slightly peraluminous composition. This sample is biotite-bearing and comes from the NE corner of the map area, in Tolstoi Township. It is possible that this area is not part of the Watabeag batholith. There are very few outcrops in this sector and the locations of the contact between

the felsic bodies are not clear. These important mineralogical and geochemical differences are a good indication that there may be an intrusion of a different suite than that of the Watabeag granodiorite at the NE corner of the area.

The porphyry dikes have variable compositions and may be separately related to either suite described before.

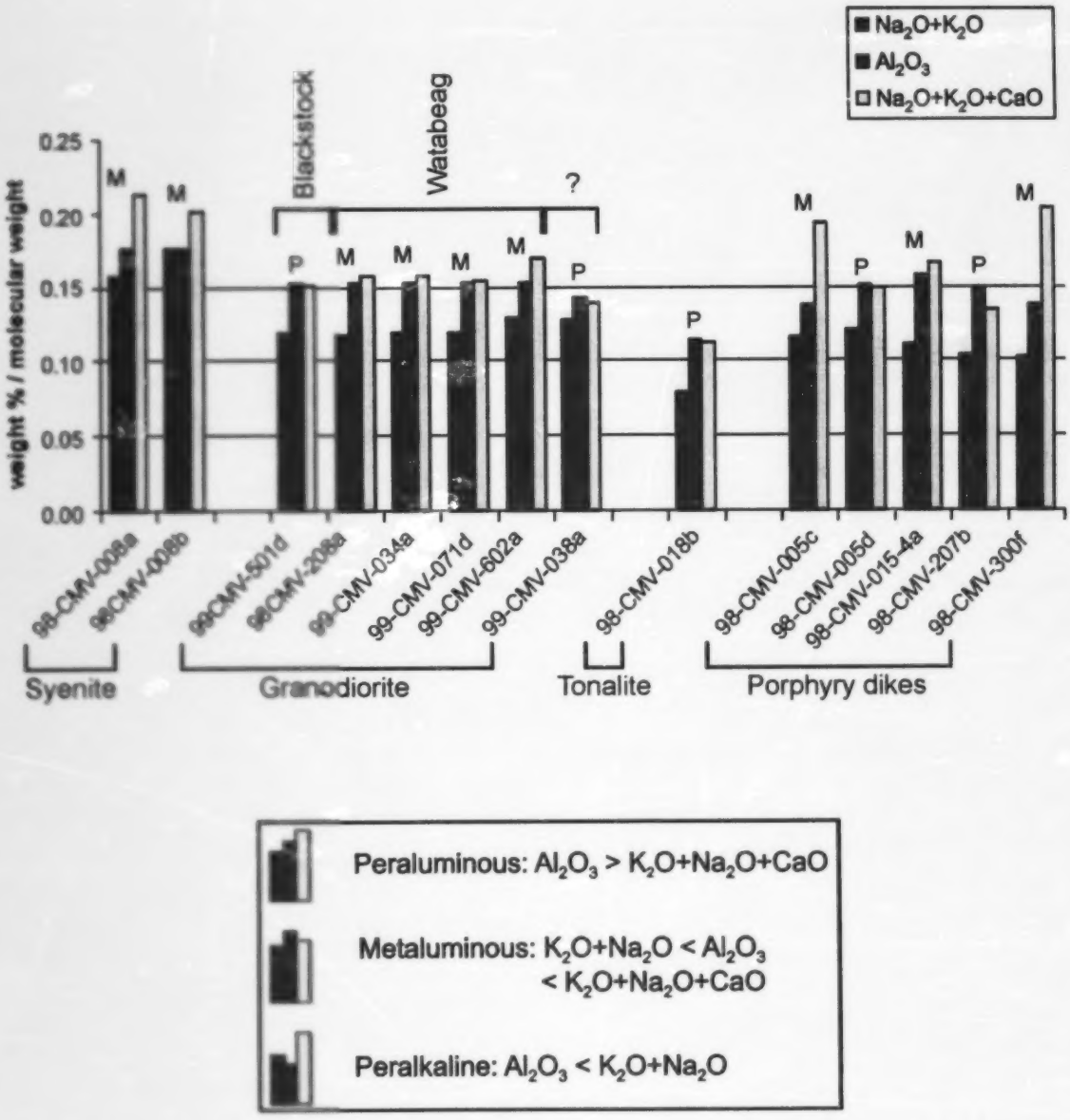

Figure 12. Graphical illustration of the relations between Al_2O_3, CaO, Na_2O and K_2O in the felsic intrusive rocks of the Watabeag area.

Mineralisation

Past and current exploration work in the Watabeag area indicate that there is high potential for various types of deposits. The calc-alkaline rocks of the Tisdale assemblage are host to zinc, copper, lead, gold and silver mineralisation. PGE showings were observed in a mafic to ultramafic intrusion in Nordica Township. Gold prospects in the mafic volcanic rocks of the Kinojevis assemblage were also observed in the north-east and the south-eastern corner of Sheraton Township. They seem to be associated with major east-west shear zones.

THE CROSS LAKE DISCOVERY

A total of 24 diamond drill holes by Golden Knight Resources Inc. and over 65 holes by Cross Lake Minerals Limited were completed to date in both the Sheraton Lake and the Cross Lake areas. There are no outcrops in this sector and all drilling targets were based on induced polarization, pulse EM, mise-à-la-masse and borehole geophysical surveys. An airborne EM and magnetic survey was also completed by the company on the portion of the area that had not previously been covered by similar surveys.

The best values reported by Cross Lake Minerals Ltd. are in the range of 1% to 6% zinc with local higher-grade pods containing 18% zinc over a true width of 3 m. Reported copper values are 1% to 3% over estimated true widths of up to 12 m (from Internet site http://www.crosslakeminerals.com). These values are all from the Cross Lake zone. Table 2 is a summary of the results obtained by the companies as reported in the previously mentioned Internet site.

Table 2. Summary of significant intersections from the Cross Lake Property, Sheraton Township. Data from Internet site http://www.crosslakeminerals.com.

Drill Hole	From (m)	To (m)	Core Length (m)	Zn (%)	Cu (%)	Ag (g/t)
CLS 97-1	173.0	177.0	4.0	2.70	-	26.2
	194.2	195.2	1.0	-	2.19	24.8
	258.0	260.0	2.0	-	2.53	8.3
CLS 97-4	152.5	192.0	39.5	1.32	-	18.5
CLS 97-6	184.5	191.5	7.0	2.60	-	32.9
	207.1	211.5	4.4	2.11	-	7.7
CLS 97-16	278.0	311.0	33.0	6.71	0.16	215.4
CLS 97-17	251.0	255.0	4.0	-	3.24	35.5
	304.5	311.0	6.5	4.18	0.12	11.5
CLS 97-18	420.5	422.0	1.5	3.35	-	13.4
CLS 97-19	183.5	200.0	16.5	1.35	-	24.0
incl.	195.1	200.0	4.9	2.46	-	15.0
CLS 97-20	192.1	194.0	1.9	2.53	-	15.5
CLS 97-21	222.5	246.5	24.0	2.16	0.40	52.8
incl.	243.5	246.5	3.0	4.52	2.74	222.0
CLS 97-22	410.1	462.5	52.4	1.41	-	10.0
incl.	417.5	423.5	6.0	2.96	-	6.5
CLS 97-23	323.0	345.5	22.5	-	1.41	7.5
incl.	330.5	335.0	4.5	-	4.74	18.5
CLS 97-24	180.5	192.5	12.0	2.80	0.12	51.6
CLS 97-25	254.0	257.0	3.0	-	2.21	8.1
	287.0	290.0	3.0	-	1.95	7.8

CLS 97-27	380.8	382.0	1.2	-	1.59	3.2
	450.5	453.5	3.0	2.73	-	6.4
CLS 97-28	615.5	621.5	6.0	1.65	-	29.3
	629.0	621.5	22.5	1.35	-	40.0
incl.	629.0	636.5	7.5	-	1.54	91.0
CLS 97-29	289.0	336.5	47.5	-	1.07	6.3
incl.	293.0	302.0	9.0	-	3.05	11.0
CLS 97-31	346.0	365.0	19.0	-	1.38	11.2
incl.	349.8	357.5	7.7	-	2.42	14.0
	395.6	398.2	2.6	2.37	1.29	123.3
CLS 97-35	227.0	231.5	4.5	2.98	-	20.7
CLS 98-37	293.7	312.5	18.8	0.12	1.73	20.9
incl.	293.7	298.5	4.8	0.28	2.65	17.8
CLS 98-38*	437.7	439.4	1.7	-	0.35	20.8
CLS 98-39**	641.0	642.5	1.5	-	-	3.0
CLS 98-40	60.5	106.1	45.6	1.83	-	34.4
incl.	60.5	71.0	10.5	2.99	-	17.6
and	101.0	106.1	5.1	2.34	0.22	125.6
CLS 98-41b	129.0	151.0	22.0	2.02		26.5
CLS 98-42	77.0	112.5	35.5	2.20	-	42.2
CLS 98-43	58.5	89.3	30.8	1.14	-	20.8
CLS 98-44	130.0	171.0	41.0	1.24	-	22.8
incl.	130.0	139.0	9.0	2.25	-	36.8
CLS 98-45	138.0	149.3	11.3	1.30	-	9.8
incl.	138.0	144.0	6.0	1.77	-	13.7
CLS 98-46	164.0	201.5	37.5	1.25	-	9.9
incl.	174.3	180.5	6.2	2.63	-	12.0
CLS 98-47	103.5	134.5	31.0	1.73	-	35.8
incl.	118.5	123.0	4.5	2.92	-	80.3
and	128.5	134.5	6.0	2.84	-	49.8
CLS 98-48	314.0	355.4	41.4	1.80	-	15.0
incl.	326.2	335.0	8.8	2.15	-	29.5
and	343.9	350.0	6.1	3.35	-	11.7
CLS 98-49	39.5	81.5	42.0	2.63	0.12	73.6
incl.	61.6	72.0	10.4	5.78	0.37	180.8
CLS 98-50	120.5	134.0	13.5	2.39	0.21	63.2
CLS 98-51	75.5	90.5	15.0	1.86	0.11	99.1
incl.	78.5	86.0	7.5	3.21	0.11	176.2
CLS 98-52	141.5	143.8	2.3	-	1.23	19.7

* Includes 7.9 g/t Gold
**Includes 4.4 g/t Gold

The host units of the mineralisation are most commonly felsic to intermediate tuffs and lapilli-tuffs. The minerals of economic interest are sphalerite, chalcopyrite and galena. The sphalerite is iron-poor with honey-yellow to beige colour, and is associated with highly sericitized and silicified zones. It is usually concentrated in approximately 1 to 10 m horizons and mostly disseminated to locally semi-massive. Higher concentrations of chalcopyrite are present in quartz stringers and occasionally form blebs and bands in the lapilli tuffs. Few small highly siliceous areas contain traces of galena.

The Cross Lake zone has generally higher concentrations of zinc relative to copper. The sphalerite is also strongly related to sericite alteration. These two elements are indicative of a lower temperature system. However, the Sheraton Lake zone generally has higher copper/zinc ratio, which would imply higher temperature. The presence of sediments and more abundant remobilised volcaniclastic units are

lithological evidence of the Sheraton zone being more distal to the main volcanic centre. It is thus difficult to actually fit the two zones into one common system as they could very well represent two distinct systems where mineralising fluids are concerned.

THE DOUGHERTY LAKE AREA

Disseminated pyrite and local quartz veins with pyrite and/or pyrrhotite with small amounts of chalcopyrite and/or galena were observed in the flows and tuffs of the calc-alkaline units in the Dougherty Lake area. The sulfide-bearing volcanic units are intensely sheared, silicified and sericitised. Black graphitic argillites and siltstone interbedded with the volcanic rocks locally contain appreciable pyrite or pyrrhotite with rare traces of red-orange sphalerite and chalcopyrite. These probably were the cause of the geophysical anomalies used as targets for most of the exploration work in the area. The best values reported by International CanAlaska Resources Limited are 1.4% Zn and 0.4% Cu over 1 m (news release, March 14, 1999). Massive sulphides have not been observed in the area to date.

The Dougherty Lake area is located in the calc-alkaline upper portion of the Tisdale assemblage, which is the same as that of the Cross Lake Minerals Limited discovery. However, the lithologies are different. Exploration work in the Dougherty Lake area has been mostly concentrated near what would be the base of the assemblage, close to the contact with the tholeiitic to komatiitic lower portion of the Tisdale. The preponderant lithologies are mafic-pillowed flows. The Cross Lake discovery is located close to the top of the assemblage or the contact with the overlying Kinojevis assemblage where felsic and intermediate volcaniclastic rocks are dominant.

THE NORDICA INTRUSION

Anomalous PGE values were obtained by Band-Ore Resources Limited in a mafic-ultramafic layered intrusion in Nordica Township. Lithologic and geochemical descriptions are provided in previous sections of this report. Results from geochemical analysis of the full spectrum of PGE and gold reported by the company are reported in Table 3.

Table 3. Geochemical analysis of PGE and Au obtained by Band-Ore Resources Limited for the Nordica intrusion.

Sample number	Au (ppb)	Ir (ppb)	Os (ppb)	Pd (ppb)	Pt (ppb)	Rh (ppb)	Ru (ppb)
51005	66	13	<10	990	210	41	<50
51006	35	12	<10	580	200	37	<50
51013	33	10	<10	670	210	31	<50
51029	3	25	40	350	120	28	130

Other assay results of up to 2640 ppm Cu and 2450 ppm Ni were also reported by Band-Ore Resources Limited.

Disseminated pyrite, pyrrhotite and local chalcopyrite are present in all the different units of the intrusion but are commonly more abundant in the hornblendites (up to around 8%) and pegmatitic troctolites (up to around 3%).

A total of six samples were also submitted for analysis of all PGE and Re and Au by the author to acquire a more complete spectrum of values for the different mafic and ultramafic units. The results are reported in Table 4 and they are represented on a multiple element diagram of metals on Figure 13.

Table 4. Geochemical analysis for the PGE, Au and Re for the Nordica intrusion.

Sample number	Rock type	Au (ppb)	Ir (ppb)	Os (ppb)	Pd (ppb)	Pt (ppb)	Rh (ppb)	Ru (ppb)	Re (ppb)
99-CMV-069c2	Hornblendite	3.0	2.49	1.1	140.7	48.1	4.92	2.4	1.28
99-CMV-039a4	Olivine-gabbronorite	9.7	5.30	4.5	180.6	38.6	6.18	7.9	1.16
99-CMV-069b3	Olivine-gabbronorite	9.4	5.39	5.1	9.7	<14	5.18	<17.0	<0.59
99-CMV-070c	Hornblendite	2.3	10.69	8.3	318.9	54.7	19.13	23.7	9.76
99-CMV-071c	Chromitite	0.5	5.91	4.7	8.2	3.0	5.29	13.5	<0.26
99-CMV-039a2	Olivine-gabbronorite	7	10.39	6.2	118.2	25.3	10.8	9.4	1.56

No economic values were found in the six samples but valuable information is obtained from the patterns on the multiple-element diagram (Figure 13). The n-shape of the pattern indicates that, in general, the PGE are enriched relative to Ni and Cu. Because the PGE are very strongly compatible with the sulphides (more than Ni and Cu), it means that the mafic magma did not suffer sulphide removal, and thus PGE removal, prior to its emplacement in the crust. It also indicates that the sulphides have concentrated the PGE.

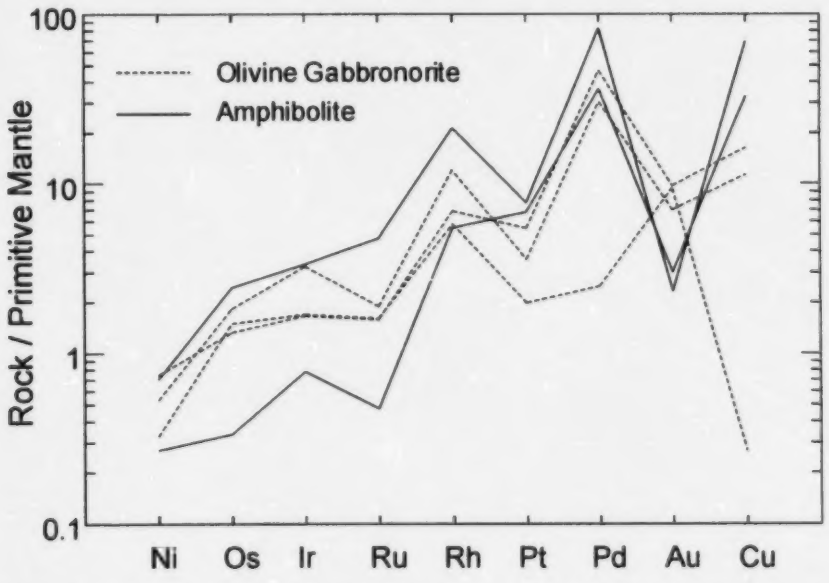

Figure 13. Mantle-normalised multiple elements diagram of PGE, Ni, Cu and Au following the order of Barnes et al. (1988) for the Nordica intrusion. Primitive mantle values from McDonough and Sun (1995).

A sample of the olivine gabbronorite shows a strong depletion in Cu, Pt and Pd compared to the others. This sample was taken in a shear zone and the depletion could indicate that Cu, Pt and Pd are more mobile than the other elements represented on this diagram.

Following the model of formation of Ni-Cu-PGE deposits (Naldrett 1981; Barnes and Francis 1985) the study of the Nordica intrusion reveals a significant potential for this type of deposit in similar mafic-ultramafic complexes in the Abitibi. The model can be summarized in four major steps: 1) parental magma must be generated by high degree of partial melting of the mantle in order to collect all the sulphides and thus the metals; 2) magma must rise quickly into the crust without undergoing sulphide saturation and segregation that would induce depletion in metal content; 3) once the magma has reached its crustal position, sulphur saturation and segregation must occur to collect and concentrate the metals and 4) sulphides can then accumulate to form a possible economic deposit.

Each of these steps can be applied to the Nordica intrusion. Geochemistry revealed a parental magma probably originating from high partial melting of the mantle by its tholeiitic affinity (flat REE-pattern) and low REE abundance. The PGE enrichment on the metal spidergram (Figure 13) indicates that the magma did not suffer sulphide removal prior to its emplacement in the crust. Furthermore, the presence of sulphides in the map unit demonstrates that sulphide saturation and segregation has occurred. To date, no massive sulphides were discovered and it is possible that sulphide accumulation did not take place in this specific area. However, since the study supports all other criteria of the model, the potential to find Ni-Cu-PGE mineralisation elsewhere in this intrusion or in a similar one remains very high.

GOLD

Gold occurrences were found at the north-eastern and south-eastern corners of Sheraton Township. Up to recently, the latter has been the locus of varied types of exploration work including geological and geophysical surveys and diamond drilling by prospectors and companies. Details can be found in the assessment files at the Resident Geologist's office in Timmins.

High gold values were found in quartz-pyrite veins in the mafic volcanic rocks or in crosscutting porphyry dikes. However, the values did not seem to have much continuity and no economically significant deposit was found to date.

In the south-eastern corner of Sheraton Township, the author observed that the quartz veins are most commonly parallel to the major deformation zone at approximately 100°. The veins also show boudinage and are folded, indicating that they precede or they are at most synchronous to the east-west deformation.

The porphyry dikes found in the area of the gold showings are spatially close and very similar in geochemical composition to the Bradley Lake syenite (see Appendix 1, samples 98-CMV-005c and d for the porphyry and samples 98-CMV-008a and b for the syenite).

Recommendations

As demonstrated, the Watabeag area bears a high potential for base metals deposits of VMS-type, Ni-Cu-PGE mineralisation related to mafic-ultramafic intrusions and possibly for gold.

The upper portion of the Tisdale assemblage where the volcanic rocks have a more felsic composition appears to be a better target for VMS mineralisation. The Cross Lake discovery in Sheraton

Township indicates that the volcaniclastic rocks were the locus of a major alteration system bearing significant amounts of metals of economic interest. Although no areas where the system would have focus in order to generate a deposit have been found to date, there is still an important portion of the assemblage that remains to be tested.

The primitive, mantle-derived geochemical signature of the mafic-ultramafic units of the Nordica intrusion is an important indicator of the potential for Ni-Cu-PGE or PGE only deposits. The intrusion is poorly characterised and its actual extent not well defined. This intrusion contains lithologies holding large amounts of magnetite, which should be perceivable on a magnetic geophysical survey. The potential of finding similar intrusions that could lead to mineralisation is high in the area. Ni-Cu-PGE rich massive sulphide deposits may produce electromagnetic anomalies that will be underlined by geophysical surveys. However, PGE deposits similar to Lac-des-Iles for example, are more difficult to discover because they are not associated with distinctive geophysical properties. Exploration for these deposits requires a good understanding of the extent of the intrusion and the orientation of the primary layering. Massive assaying across stratigraphy is the best and only way to define PGE mineralisation once it has been demonstrated that the magma is of the right geochemical composition.

All major gold deposits in the Abitibi greenstone belt are in or adjacent to the Porcupine-Destor deformation zone (PDDZ) and the Larder Lake-Cadillac deformation zone (LLCDF), which are of regional extent. The Watabeag area is located over 12 km south of the PDDZ and 20 km north of the LLCDF. Although the style of the mineralisation closely resembles that of the large deposits in the two deformation zones, the Watabeag area could be too far from those regional breaks that seem to have focused the gold mineralisation and would thus not raise a flag for high potential. However, the presence of the porphyry dikes that are possibly related to the syenite pluton opens up the possibility for the type of deposit related to alkalic intrusions. An example is the Canadian Arrow Mine in south-west Hislop Township, 20 km to the north-east of Sheraton Township, which is located further from the PDDZ than the majority of gold deposits in this part of the Abitibi.

Appendix 1

Major oxides and trace elements geochemistry for the Watabeag area.

All major oxide values are in percent (%); all trace element values are in parts per million (ppm).

Abbreviations: mv = mafic volcanic; iv = intermediate volcanic; fv = felsic volcanic; chl = chlorite; NA = not analysed; qz = quartz; pil. = pillow; hetero. = heterolithic; fp = feldspar; granodio. = granodiorite; amph = amphibolite; ol gabbnor = olivine gabbronorite.

Note: To save space, sample numbers in appendix 1 have been shortened; the initials "CMV-" have been dropped from every sample number.

Tholeiitic volcanic rocks

Sample	98-002b	98-004a	98-007a	98-007b	98-014c	98-015-3a	98-017a	98-018a	98-019b	98-024a
Township	Sheraton	Sheraton	Sheraton	Sheraton	Sheraton	Sheraton	Sheraton	Sheraton	Sheraton	Sheraton
Rock Type	mv breccia	mv massive	mv chl-schist	mv breccia	mv variolitic	mv massive	mv pillowed	mv massive	mv pillowed	mv breccia
SiO2 (%)	66.72	67.09	49.20	63.62	68.46	53.49	64.43	54.49	57.23	53.00
TiO2	0.75	0.76	0.46	0.96	0.82	1.55	1.10	1.01	1.11	1.65
Al2O3	10.59	11.29	10.84	13.69	13.08	14.80	17.44	16.78	14.01	14.05
Fe2O3	10.13	12.13	9.80	10.43	4.87	15.25	2.89	8.79	4.31	17.20
MnO	0.06	0.07	0.15	0.14	0.05	0.23	0.02	0.13	0.14	0.25
MgO	4.61	2.95	18.17	1.60	0.66	3.01	0.73	4.60	9.39	3.07
CaO	1.70	0.29	5.55	3.31	6.50	6.07	1.81	7.34	7.77	7.11
Na2O	2.98	0.12	0.83	4.98	4.66	5.22	9.52	4.55	4.47	2.97
K2O	0.44	2.10	0.27	0.09	0.04	0.47	0.06	0.49	0.83	0.53
P2O5	0.17	0.19	0.08	0.20	0.13	0.25	0.16	0.19	0.08	0.12
LOI	2.66	2.74	4.61	1.26	0.63	0.50	1.02	1.50	1.22	0.56
S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total	100.81	99.73	99.96	100.28	99.90	100.84	99.18	99.87	100.56	100.51
Cr (ppm)	30	16	>500	157	147	133	231	194	128	152
Ni	21	15	701	39	16	38	27	75	75	75
Co	13	7	62	20	9	33	12	26	9	54
Sc	16	16	24	22	16	33	25	26	56	44
V	70	44	146	86	85	136	214	189	167	407
Cu	57	13	<5	13	20	105	61	27	<5	102
Pb	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Zn	55	136	100	75	19	131	31	97	90	156
W	<40	<40	<40	<40	<40	<40	<40	<40	<40	<40
Mo	<8	<8	10.00	13.00	15.00	22.00	13.00	10.00	11.00	<8
Rb	7	34	10	2	1	15	2	17	28	13
Cs	0.20	0.67	2.52	0.57	0.03	0.27	0.05	0.27	0.53	0.58
Ba	184	2372	76	80	22	105	29	196	157	172
Sr	61	15	56	147	437	193	107	285	252	122
Ga	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ta	0.88	0.80	0.31	0.75	1.15	0.49	0.51	0.58	0.34	0.38
Nb	11.9	10.8	2.0	10.0	16.6	5.8	5.8	6.5	5.9	3.6
Hf	5.61	5.76	1.60	2.93	6.60	2.22	2.97	2.90	0.91	1.41
Zr	324	337	62	266	408	124	129	133	77	89
Y	110	119	10	87	134	53	18	20	20	32
Th	1.39	1.33	0.92	1.38	1.80	0.62	1.46	1.73	0.49	0.35
U	0.28	0.29	0.23	0.27	0.36	0.15	0.34	0.36	0.03	0.08
La	13.16	16.16	6.62	13.89	18.60	7.61	12.63	12.94	1.67	4.36
Ce	36.85	43.74	14.47	35.54	49.04	19.88	30.75	30.10	4.99	11.85
Pr	6.02	7.38	1.91	5.64	7.80	3.23	4.18	4.12	0.86	1.94
Nd	29.76	36.35	7.81	27.73	38.39	16.01	17.57	17.36	4.76	9.87
Sm	9.40	9.89	1.84	8.45	12.02	4.98	3.98	4.02	1.65	3.24
Eu	2.09	2.79	0.58	2.26	3.05	1.74	1.32	1.16	0.78	1.08
Gd	11.58	8.23	1.87	10.64	15.19	6.23	3.41	3.83	2.30	4.24
Tb	2.08	1.18	0.28	1.88	2.77	1.12	0.55	0.61	0.40	0.77
Dy	13.96	7.15	1.93	12.11	18.61	7.45	3.29	3.62	2.64	5.17
Ho	3.17	1.48	0.40	2.64	4.30	1.66	0.67	0.77	0.66	1.19
Er	9.33	4.70	1.20	7.49	12.80	4.87	1.85	2.23	2.08	3.49
Tm	1.41	0.74	0.17	1.04	1.90	0.72	0.25	0.33	0.34	0.52
Yb	9.09	5.57	1.21	6.27	12.28	4.84	1.59	2.08	2.40	3.48
Lu	1.40	0.89	0.18	0.89	1.87	0.77	0.25	0.33	0.40	0.54
Be	<3	<3	<3	<3	<3	<3	<3	<3	<3	3.00

Tholeiitic volcanic rocks, cont'd

Sample	98-027b	98-029a	98-033a	98-201a	98-203a	98-203b	99-007a	99-050a	99-215a	99-530a
Township	Sheraton	Sheraton	Sheraton	Sheraton	Sheraton	Sheraton	Timmins	Nordica	Timmins	Michie
Rock Type	mv	mv	mv	mv	mv	mv	mv	mv	mv	mv
	breccia	breccia	breccia	massive	massive	massive	variolitic	pillowed	massive	shear zone
SiO2 (%)	57.32	66.52	42.81	51.12	46.69	49.95	51.21	50.41	49.15	57.48
TiO2	1.97	1.04	1.81	0.73	0.73	0.74	1.64	2.04	0.77	1.88
Al2O3	17.28	12.16	15.46	16.53	16.24	16.76	13.88	13.00	14.66	12.74
Fe2O3	9.77	9.02	21.65	7.91	11.41	6.53	16.72	18.91	12.69	14.57
MnO	0.13	0.06	0.25	0.18	0.20	0.14	0.17	0.34	0.21	0.30
MgO	1.87	2.51	11.05	6.85	8.80	5.00	6.83	3.11	7.75	2.54
CaO	3.09	1.37	1.23	10.55	10.79	9.93	6.24	8.39	9.08	5.92
Na2O	4.63	4.81	0.15	2.64	1.68	2.96	2.53	2.53	2.60	3.85
K2O	1.64	0.04	0.31	0.22	0.07	0.31	0.57	0.32	1.23	0.34
P2O5	0.12	0.17	0.08	0.04	0.04	0.04	0.11	0.35	0.05	0.31
LOI	1.65	2.27	6.12	2.85	3.41	6.86	0.94	0.50	1.46	0.86
S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total	99.47	99.97	100.92	99.62	100.06	99.22	100.84	99.90	99.65	100.79
Cr (ppm)	180	123	156	410	368	403	82	68	139	5
Ni	75	24	95	177	171	172	66	33	90	14
Co	48	19	42	55	55	61	45	47	44	35
Sc	46	22	45	44	43	43	36	34	42	35
V	503	91	402	307	296	299	372	116	279	111
Cu	127	<5	147	124	145	132	103	132	161	48
Pb	NA	NA	NA	NA	NA	NA	2	2	3	5
Zn	107	62	275	84	86	140	105	204	117	173
W	<40	<40	<40	<40	<40	<40	<40	<40	<40	<40
Mo	<8	<8	<8	15.00	13.00	15.00	<8	<8	11.00	<8
Rb	60	1	11	8	1	9	17	9	51	7
Cs	3.73	0.06	1.20	0.32	0.10	0.30	1.19	0.14	2.23	0.17
Ba	485	21	136	154	48	87	249	152	171	115
Sr	118	48	44	170	116	134	120	109	99	77
Ga	NA	NA	NA	NA	NA	NA	18	21	14	20
Ta	0.48	0.75	0.40	0.25	0.24	0.25	0.23	0.38	0.11	0.46
Nb	5.2	9.2	3.8	1.3	1.2	1.3	3.8	6.5	2.0	6.7
Hf	2.01	4.41	1.34	0.52	0.54	0.46	2.81	3.82	1.51	4.55
Zr	129	279	101	32	28	31	95	115	45	155
Y	31	73	43	13	14	10	38	51	22	60
Th	0.70	1.07	0.36	0.14	0.10	0.17	0.42	0.37	0.36	0.72
U	0.15	0.22	0.09	0.06	0.02	0.10	0.10	0.12	0.12	0.18
La	7.52	3.58	4.25	1.64	1.32	2.94	5.49	6.33	2.88	7.77
Ce	19.20	12.11	10.88	4.40	3.79	7.10	13.73	18.27	7.12	20.06
Pr	2.89	2.42	1.69	0.71	0.66	1.05	2.21	3.41	1.17	3.43
Nd	13.45	13.64	8.32	3.61	3.56	4.94	11.54	18.30	5.99	18.91
Sm	3.56	5.94	2.75	1.20	1.22	1.50	3.89	6.08	1.89	6.57
Eu	1.10	1.39	1.19	0.57	0.52	0.65	1.24	2.36	0.66	2.03
Gd	3.66	7.51	4.02	1.62	1.70	1.71	4.77	7.52	2.56	7.72
Tb	0.63	1.44	0.74	0.30	0.31	0.30	0.86	1.40	0.50	1.40
Dy	4.04	9.82	5.11	1.95	2.18	2.03	6.35	8.43	3.32	9.67
Ho	0.86	2.19	1.18	0.43	0.49	0.43	1.39	2.08	0.79	2.16
Er	2.50	6.62	3.42	1.26	1.46	1.24	3.79	5.93	2.36	6.04
Tm	0.36	1.00	0.51	0.18	0.22	0.18	0.68	0.92	0.36	1.04
Yb	2.51	6.35	3.25	1.18	1.39	1.20	3.85	5.66	2.48	6.04
Lu	0.37	0.97	0.50	0.16	0.20	0.16	0.64	0.96	0.39	0.95
Be	4.00	<3	3.00	<3	<3	<3	<3	<3	<3	<3

Tholeiitic volcanic rocks, cont'd

Sample	99-532e	99-541a	99-543b	99-546b	99-547d	99-554a	99-557a	99-563a	99-567b	99-573a
Township	Michie	Timmins	Michie	Timmins	Timmins	Timmins	Timmins	Blackstock	Timmins	Timmins
Rock Type	mv	mv	mv	mv	mv	mv	mv	mv	mv	mv
	massive	tuff	massive	qz phyric	massive	variolitic	massive	massive	massive	variolitic
SiO2 (%)	52.42	54.18	54.28	68.11	51.30	51.54	52.44	59.29	56.82	66.26
TiO2	1.30	1.61	1.73	0.86	1.36	1.83	1.80	1.57	1.49	1.10
Al2O3	13.95	12.57	13.84	12.86	13.74	13.21	15.39	13.90	13.21	12.45
Fe2O3	14.69	16.36	15.85	7.22	15.02	18.37	13.80	11.47	16.23	9.17
MnO	0.21	0.21	0.23	0.09	0.21	0.25	0.26	0.20	0.22	0.11
MgO	5.42	3.34	3.85	1.64	6.53	4.08	3.90	3.94	2.23	1.66
CaO	8.87	7.91	4.96	4.24	6.93	8.42	8.63	5.57	5.07	4.27
Na2O	2.67	2.33	4.29	4.80	3.62	2.22	3.60	3.27	3.40	4.25
K2O	0.49	0.11	0.59	0.15	0.23	0.29	0.29	0.29	0.40	0.31
P2O5	0.10	0.26	0.14	0.14	0.09	0.13	0.12	0.11	0.51	0.22
LOI	0.61	1.19	0.74	0.52	0.82	0.51	0.45	0.89	1.42	0.54
S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total	100.73	100.07	100.50	100.63	99.85	100.85	100.68	100.50	101.00	100.34
Cr (ppm)	63	31	6	81	61	7	85	18	22	38
Ni	63	30	30	20	61	37	61	22	14	17
Co	40	32	38	11	42	45	50	35	19	14
Sc	37	32	33	15	39	37	42	39	25	20
V	302	165	369	84	336	415	387	353	20	93
Cu	75	135	121	32	59	18	63	28	20	37
Pb	1	2	1	2	1	1	3	1	6	2
Zn	130	120	157	49	105	144	135	87	173	80
W	<40	<40	<40	<40	<40	<40	<40	<40	<40	<40
Mo	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8
Rb	11	1	27	2	4	7	8	6	14	6
Cs	0.21	0.07	1.61	0.17	0.28	0.15	0.78	0.81	1.98	0.34
Ba	76	41	278	84	83	78	111	49	96	228
Sr	105	93	45	90	86	99	103	57	101	108
Ga	17	19	20	22	16	20	18	17	23	23
Ta	0.22	0.36	0.33	0.97	0.23	0.32	0.26	0.23	0.61	0.99
Nb	3.7	5.7	5.1	14.4	3.4	4.8	4.3	3.9	9.8	14.6
Hf	2.52	3.65	3.31	10.37	2.31	3.41	3.20	2.79	6.42	10.20
Zr	92	131	114	350	82	114	109	97	219	333
Y	33	47	41	105	31	41	40	37	79	106
Th	0.45	0.54	0.59	1.78	0.38	0.54	0.44	0.39	0.97	1.69
U	0.12	0.16	0.16	0.44	0.10	0.13	0.12	0.13	0.28	0.48
La	5.96	6.85	4.05	12.99	4.37	6.53	5.41	3.94	12.99	19.30
Ce	12.75	18.77	12.88	36.43	11.63	16.57	14.63	10.78	35.84	50.46
Pr	2.24	2.99	2.33	5.24	1.95	2.64	2.33	1.78	5.74	7.72
Nd	11.90	15.97	12.38	27.67	10.10	13.96	12.08	9.83	30.28	40.14
Sm	3.53	5.18	4.51	9.97	3.21	4.48	3.96	3.46	9.51	12.37
Eu	1.13	1.54	1.27	2.39	1.03	1.34	1.26	1.10	2.73	3.03
Gd	4.32	6.42	5.37	12.58	4.07	5.45	5.03	4.48	11.56	14.86
Tb	0.80	1.14	0.96	2.36	0.67	0.93	0.96	0.77	1.98	2.72
Dy	5.36	7.97	6.82	17.36	4.80	6.84	6.73	5.91	14.06	18.99
Ho	1.18	1.77	1.51	3.95	1.12	1.46	1.41	1.40	3.00	4.21
Er	3.28	5.02	4.31	11.46	3.10	4.05	3.93	3.84	8.29	11.70
Tm	0.55	0.88	0.72	2.08	0.52	0.70	0.70	0.69	1.50	2.10
Yb	3.50	4.90	4.56	12.36	3.14	4.18	3.88	4.17	8.74	12.04
Lu	0.52	0.81	0.66	1.93	0.48	0.66	0.67	0.71	1.30	1.89
Be	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3

	Tholeiitic volcanic rocks, cont'd				Calc-alkaline volcanic rocks					
Sample	99-588b	99-596b1	99-599a	99-600a	98-100a	98-101a	98-101b	98-103c	98-106a	98-205f
Township	Michie	Nordica	Nordica	Nordica	Sheraton	Sheraton	Sheraton	Sheraton	Sheraton	Sheraton
Rock Type	mv	mv	mv	mv	mv	iv	iv	fv	iv	iv
	variolitic	massive	pillowed	massive	breccia	lapilli tuff	crystal tuff	massive	tuff	lapilli tuff
SiO2 (%)	64.51	46.89	52.47	50.85	39.09	54.33	55.18	70.05	56.64	66.78
TiO2	0.98	0.29	1.29	1.94	0.45	1.00	0.97	1.12	0.77	0.78
Al2O3	12.69	6.97	14.30	13.41	10.94	14.89	14.44	14.96	14.90	12.25
Fe2O3	8.45	10.58	12.99	18.12	10.60	7.38	7.46	1.44	6.00	9.13
MnO	0.11	0.19	0.21	0.26	0.27	0.14	0.39	0.02	0.10	0.19
MgO	2.56	21.06	6.16	4.63	10.47	5.92	2.82	1.31	3.94	1.28
CaO	4.05	9.29	9.79	8.32	13.80	5.49	6.38	1.78	5.47	0.23
Na2O	4.48	0.42	2.77	2.74	1.15	4.30	3.86	5.02	2.22	0.62
K2O	0.19	0.09	0.29	0.16	0.41	0.08	0.79	1.02	2.94	2.59
P2O5	0.21	<0.01	0.10	0.13	0.06	0.20	0.28	0.29	0.15	0.14
LOI	0.71	4.14	0.64	0.45	12.85	5.88	6.78	2.13	6.62	4.55
S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total	98.94	99.92	101.01	101.01	100.09	99.61	99.35	99.14	99.75	98.54
Cr (ppm)	347	>500	100	40	>500	487	394	79	214	197
Ni	22	955	84	45	295	188	158	47	75	57
Co	10	67	41	45	44	39	28	7	22	22
Sc	18	17	36	41	31	22	20	11	18	18
V	69	131	307	443	176	190	176	130	150	146
Cu	25	13	26	242	58	57	103	114	55	19
Pb	2	1	1	2	NA	NA	NA	NA	NA	NA
Zn	69	105	109	147	88	112	216	128	91	11118
W	<40	<40	<40	<40	<40	<40	<40	<40	<40	133.00
Mo	<8	<8	<8	<8	9.00	23.00	12.00	16.00	12.00	<8
Rb	4	3	8	4	9	2	22	32	93	66
Cs	0.25	0.14	0.10	0.40	0.26	0.12	0.56	0.62	1.68	1.76
Ba	79	37	112	58	102	53	249	267	570	540
Sr	123	31	99	94	140	210	250	216	152	99
Ga	23	7	17	18	NA	NA	NA	NA	NA	NA
Ta	0.86	0.03	0.25	0.32	0.26	0.55	0.63	0.70	0.58	0.34
Nb	13.9	0.4	3.3	4.7	1.6	6.5	7.3	8.4	6.5	2.8
Hf	9.84	0.63	2.31	3.18	0.61	3.20	5.50	7.40	4.36	2.92
Zr	325	19	80	106	49	165	222	293	171	118
Y	103	9	30	41	9	21	22	16	20	20
Th	1.64	0.10	0.42	0.46	0.55	2.48	4.26	5.35	2.73	1.96
U	0.44	0.12	0.11	0.12	0.12	0.58	0.97	1.10	0.70	0.47
La	14.12	1.62	4.08	5.61	4.91	14.07	29.60	28.46	14.26	12.13
Ce	36.89	2.61	10.87	14.90	11.73	33.62	68.17	64.48	32.44	28.17
Pr	6.00	0.59	1.90	2.59	1.71	4.66	9.28	8.63	4.45	3.83
Nd	30.97	2.74	10.00	13.85	7.47	19.42	36.92	34.34	18.67	16.02
Sm	10.71	0.76	3.28	4.45	1.81	4.27	6.92	6.69	4.27	3.34
Eu	2.66	0.30	1.04	1.18	0.56	1.14	1.59	1.52	1.30	1.60
Gd	13.67	1.03	3.76	5.28	1.74	3.92	5.37	5.25	3.78	2.77
Tb	2.53	0.20	0.68	0.92	0.26	0.58	0.72	0.72	0.57	0.37
Dy	18.37	1.34	5.14	7.12	1.71	3.62	4.12	4.01	3.40	2.14
Ho	3.98	0.30	1.11	1.46	0.35	0.71	0.76	0.68	0.69	0.41
Er	11.38	0.88	2.86	4.07	1.03	2.02	2.18	1.87	2.03	1.27
Tm	2.03	0.16	0.54	0.76	0.14	0.27	0.29	0.23	0.28	0.18
Yb	11.69	0.83	2.98	4.34	0.92	1.76	1.92	1.48	1.90	1.36
Lu	1.82	0.14	0.49	0.65	0.14	0.26	0.30	0.21	0.29	0.21
Be	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3

Calc-alkaline volcanic rocks, cont'd

Sample	98-206h	98-209b	98-209k	98-209l	98-300d	99-004c	99-061a	99-063a	99-065d	99-067a
Township	Sheraton	Sheraton	Sheraton	Sheraton	Sheraton	Timmins	Timmins	Timmins	Timmins	Timmins
Rock Type	iv	iv	fv	iv	iv	mv	mv	mv	iv	mv
	lapilli tuff	crystal tuff	massive	lapilli tuff	lapilli tuff	pil. breccia	pillowed	pil. breccia	tuff	pil. breccia
SiO2 (%)	73.93	58.83	77.72	59.54	54.21	46.86	55.97	56.98	62.27	54.67
TiO2	0.76	0.91	0.79	0.76	0.88	1.32	1.06	0.74	0.71	1.18
Al2O3	14.49	15.69	10.05	16.20	15.29	12.33	17.26	15.95	15.79	14.92
Fe2O3	2.32	8.28	4.42	6.85	6.02	11.21	7.92	5.92	7.01	8.53
MnO	0.00	0.17	0.02	0.32	0.13	0.20	0.11	0.20	0.10	0.12
MgO	0.44	1.71	0.64	2.35	2.52	12.57	4.82	3.56	2.46	7.67
CaO	0.07	4.05	0.43	3.98	8.71	10.35	4.73	11.36	3.60	6.21
Na2O	0.21	4.82	0.46	0.73	3.10	0.67	3.38	1.95	4.72	5.03
K2O	4.57	0.83	2.15	2.71	1.62	1.26	2.05	1.54	0.78	0.51
P2O5	0.05	0.19	0.24	0.16	0.20	0.24	0.21	0.16	0.15	0.21
LOI	2.92	4.48	3.43	6.22	5.80	2.41	2.02	0.91	2.35	1.27
S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total	99.76	99.96	100.35	99.82	98.48	99.42	99.53	99.27	99.94	100.32
Cr (ppm)	109	128	108	109	244	485	283	72	146	328
Ni	52	113	56	45	90	324	100	57	94	183
Co	26	26	37	16	23	43	25	13	24	32
Sc	11	24	9	15	19	18	19	11	12	17
V	101	178	81	122	154	166	160	103	97	149
Cu	1514	77	99	153	62	52	37	11	39	43
Pb	NA	NA	NA	NA	NA	2	5	4	2	3
Zn	68	94	69	106	78	106	111	79	73	106
W	<40	<40	<40	<40	<40	<40	<40	<40	<40	<40
Mo	15.00	11.00	58.00	8.00	11.00	<8	<8	<8	<8	<8
Rb	103	32	61	88	59	45	53	43	14	14
Cs	2.68	1.28	1.56	2.60	1.61	1.36	4.23	0.89	0.49	1.28
Ba	1222	114	270	440	370	465	565	236	285	417
Sr	136	153	121	218	287	173	232	240	230	285
Ga	NA	NA	NA	NA	NA	15	20	17	18	18
Ta	0.39	0.47	0.43	0.44	0.55	0.49	0.58	0.48	0.54	0.60
Nb	3.5	4.6	4.0	3.9	6.7	9.0	8.7	7.4	7.4	10.2
Hf	4.64	3.94	4.71	4.69	3.97	3.04	4.38	3.63	4.47	4.04
Zr	180	178	198	184	158	120	170	155	176	169
Y	16	25	17	22	22	19	21	18	19	18
Th	3.19	2.94	2.92	3.34	2.74	0.88	2.14	2.23	2.72	1.60
U	0.83	0.68	0.79	0.74	0.66	0.21	0.56	0.54	0.68	0.39
La	18.84	20.22	17.53	19.03	21.01	13.65	22.90	18.14	21.42	14.54
Ce	41.62	45.10	37.07	42.35	46.14	31.99	47.83	35.83	43.40	35.03
Pr	5.40	6.19	5.06	5.63	6.15	4.63	6.34	4.58	5.04	4.67
Nd	21.03	25.89	20.96	22.70	25.43	20.54	26.68	18.33	20.56	20.76
Sm	4.16	5.49	4.43	4.61	5.08	4.46	5.38	3.45	4.08	4.54
Eu	1.34	1.41	1.13	1.14	1.49	1.33	1.41	1.09	1.03	1.29
Gd	3.23	4.91	3.04	3.56	4.52	3.99	4.64	3.52	3.54	3.92
Tb	0.44	0.70	0.36	0.44	0.63	0.62	0.68	0.51	0.56	0.59
Dy	2.59	4.30	1.90	2.46	3.84	3.45	3.78	3.16	3.12	3.38
Ho	0.49	0.84	0.32	0.42	0.74	0.65	0.73	0.62	0.67	0.67
Er	1.55	2.48	1.00	1.39	2.15	1.78	1.94	1.68	1.84	1.63
Tm	0.23	0.35	0.14	0.21	0.30	0.28	0.30	0.24	0.29	0.29
Yb	1.73	2.28	1.02	1.63	1.94	1.79	1.86	1.71	1.94	1.71
Lu	0.27	0.35	0.16	0.27	0.30	0.28	0.26	0.24	0.30	0.24
Be	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3

Calc-alkaline volcanic rocks, cont'd

Sample	99-068a1	99-202c	99-203d	99-206d	99-209b	99-211a	99-218d	99-501a	99-561a	99-581a
Township	Timmins	Timmins	Timmins	Timmins	Timmins	Timmins	Timmins	Timmins	Timmins	Michie
Rock Type	mv	iv	iv	iv	iv	iv	mv	iv	iv	iv
	pillowed	hetero. tuff	tuff	crystal tuff	lapilli tuff	lapilli tuff	fp phyric	massive	tuff	crystal tuff
SiO2 (%)	59.37	60.27	59.27	60.38	54.76	53.81	59.84	66.80	55.93	59.15
TiO2	0.65	1.02	0.87	1.26	1.30	1.14	0.89	0.65	0.87	0.64
Al2O3	14.58	17.25	14.98	16.82	15.24	16.07	17.18	13.92	15.95	16.52
Fe2O3	13.05	5.92	6.61	5.51	8.89	9.00	5.52	5.63	8.30	6.19
MnO	0.29	0.09	0.10	0.08	0.17	0.16	0.14	0.10	0.16	0.09
MgO	2.87	2.67	4.71	2.74	5.32	5.10	2.73	2.23	5.57	5.56
CaO	5.19	5.45	6.20	7.40	5.07	7.30	6.66	5.53	6.89	5.58
Na2O	0.45	3.94	3.54	3.61	3.99	2.51	4.11	2.95	4.12	3.81
K2O	1.93	1.95	0.93	0.68	1.08	1.27	0.60	1.22	1.34	0.77
P2O5	0.15	0.24	0.17	0.33	0.27	0.23	0.15	0.15	0.14	0.11
LOI	2.28	0.82	1.17	0.71	2.62	3.15	0.71	0.90	0.94	1.94
S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total	100.81	99.62	98.55	99.52	98.71	99.74	98.53	100.08	100.21	100.36
Cr (ppm)	178	55	240	160	395	122	108	56	256	298
Ni	122	26	143	65	179	58	70	33	78	135
Co	23	14	27	21	35	29	24	13	26	23
Sc	16	13	14	13	18	21	15	10	20	12
V	86	124	126	130	176	179	150	66	174	96
Cu	43	29	50	32	47	26	40	38	54	45
Pb	2	7	5	6	3	4	6	6	3	3
Zn	143	104	100	82	93	116	95	82	107	74
W	<40	<40	<40	<40	<40	<40	<40	<40	<40	<40
Mo	<8	14.00	15.00	17.00	11.00	13.00	18.00	<8	<8	<8
Rb	55	59	27	19	31	32	20	41	30	23
Cs	1.99	2.57	1.62	1.18	0.74	0.30	1.42	1.49	0.78	0.69
Ba	314	690	253	183	404	249	259	291	393	351
Sr	115	318	169	394	229	259	250	191	116	278
Ga	16	23	20	20	18	20	20	17	17	16
Ta	0.50	0.72	0.54	0.83	0.68	0.65	0.49	0.72	0.28	0.38
Nb	6.8	11.9	8.9	15.8	12.7	11.2	7.2	9.8	4.8	5.1
Hf	3.78	5.90	4.33	5.53	4.65	5.27	4.25	5.11	2.90	3.40
Zr	155	213	162	216	176	183	138	199	115	134
Y	19	26	22	24	27	31	16	26	19	16
Th	2.57	3.13	2.62	2.72	1.70	2.18	2.32	3.74	1.23	1.58
U	0.53	0.83	0.66	0.68	0.46	0.55	0.68	0.80	0.26	0.40
La	19.31	22.14	19.66	24.48	19.01	19.88	14.31	29.02	10.31	12.92
Ce	40.85	47.92	42.22	54.64	43.90	44.52	29.68	56.11	25.73	26.04
Pr	4.53	6.91	6.05	8.02	6.47	6.54	4.03	7.04	3.34	3.33
Nd	17.68	27.15	23.21	31.20	25.67	26.49	16.02	26.69	14.88	13.63
Sm	3.95	5.62	4.63	6.06	5.40	5.58	3.43	5.53	3.33	2.84
Eu	0.89	1.47	1.28	1.55	1.54	1.44	1.22	1.19	1.00	0.84
Gd	3.46	4.49	3.66	4.59	4.79	5.22	3.14	4.69	3.26	2.67
Tb	0.52	0.73	0.60	0.68	0.69	0.82	0.49	0.74	0.49	0.40
Dy	3.16	4.19	3.52	3.94	4.35	5.13	2.82	4.44	3.23	2.55
Ho	0.65	0.95	0.76	0.82	0.93	1.08	0.61	0.82	0.66	0.54
Er	1.86	2.66	2.17	2.35	2.49	2.97	1.67	2.34	1.76	1.40
Tm	0.29	0.38	0.31	0.30	0.36	0.44	0.23	0.40	0.29	0.24
Yb	1.91	2.50	1.99	1.99	2.21	2.76	1.56	2.54	1.63	1.50
Lu	0.32	0.40	0.29	0.29	0.36	0.46	0.23	0.40	0.28	0.22
Be	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3

Felsic and intermediate intrusive rocks

Sample	99-595a	98-005c	98-005d	98-008a	98-008b	98-015-4a	98-018b	98-207b	98-208a	98-300f
Township	Blackstock	Sheraton	Sheraton	Sheraton	Sheraton	Sheraton	Sheraton	Sheraton	Sheraton	Sheraton
Rock Type	mv fp physic	porphyry	porphyry	syenite	syenite	porphyry	tonalite	porphyry	granodio.	porphyry
SiO2 (%)	68.48	62.90	69.71	61.19	63.96	66.57	74.44	69.57	69.19	58.72
TiO2	0.38	0.45	0.27	0.33	0.20	0.40	0.26	0.32	0.23	0.37
Al2O3	14.90	14.09	15.41	17.88	17.90	16.14	11.56	15.24	15.57	14.02
Fe2O3	3.76	4.35	1.73	3.11	1.88	2.97	6.10	2.35	1.51	4.22
MnO	0.07	0.08	0.02	0.08	0.08	0.04	0.06	0.02	0.02	0.08
MgO	1.27	3.48	1.05	0.93	0.34	1.55	0.37	1.02	0.83	3.72
CaO	3.38	4.34	1.56	3.16	1.47	3.11	1.91	1.73	2.26	5.60
Na2O	2.85	4.60	6.67	7.06	9.02	6.42	4.71	5.13	5.83	6.31
K2O	3.73	3.60	1.26	4.05	2.81	0.69	0.26	1.93	2.25	0.09
P2O5	0.08	0.30	0.16	0.14	0.03	0.11	0.03	0.08	0.08	0.31
LOI	1.11	0.95	1.59	0.56	0.59	1.24	0.93	2.36	0.87	5.34
S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total	100.01	99.34	99.43	98.49	98.28	99.24	100.63	99.75	98.64	98.78
Cr (ppm)	46	166	43	41	98	133	124	14	25	169
Ni	23	47	18	13	6	28	6	9	10	46
Co	7	17	6	7	<5	8	<5	5	<5	16
Sc	7	11	3	3	1	4	4	2	3	11
V	37	94	34	65	29	48	7	41	29	94
Cu	20	30	6	15	<5	13	7	6	<5	29
Pb	11	NA	NA	NA	NA	NA	NA	NA	NA	NA
Zn	73	91	58	93	66	57	35	82	68	93
W	<40	<40	<40	<40	<40	<40	<40	<40	<40	<40
Mo	<8	11.00	12.00	14.00	15.00	14.00	<8	16.00	17.00	10.00
Rb	81	72	28	57	33	17	6	71	46	2
Cs	2.04	0.37	0.62	0.56	0.35	0.28	0.17	4.01	0.58	0.17
Ba	657	1200	1538	1878	2189	457	114	607	1073	1226
Sr	217	771	974	2909	1431	667	101	278	1160	592
Ga	19	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ta	0.84	0.41	0.30	0.67	0.54	0.37	1.40	0.33	0.27	0.33
Nb	10.4	4.6	2.5	12.6	9.9	4.0	19.3	2.3	1.7	3.2
Hf	4.74	3.21	3.04	4.83	4.13	2.23	6.34	2.24	2.77	2.58
Zr	175	124	117	306	163	102	1050	89	88	94
Y	24	13	2	6	6	2	181	0	0	7
Th	4.31	5.06	8.53	11.26	9.80	1.61	2.24	1.19	2.03	4.06
U	1.01	1.57	1.72	1.92	2.99	0.48	0.47	0.85	0.69	1.43
La	26.20	29.92	56.05	108.35	31.14	11.88	21.49	6.61	9.75	22.61
Ce	52.98	62.62	105.82	205.82	83.35	25.57	58.57	13.78	19.86	46.22
Pr	6.36	8.21	13.22	25.10	11.34	3.25	9.51	1.75	2.55	5.95
Nd	25.24	32.14	48.82	88.36	44.04	12.67	46.62	6.90	10.04	23.31
Sm	4.95	6.08	7.24	13.55	7.95	2.35	14.48	1.48	1.94	4.26
Eu	1.10	1.71	1.93	3.20	1.87	0.64	3.39	0.47	0.67	1.31
Gd	4.48	4.44	4.09	7.72	4.87	1.61	17.34	1.12	1.23	2.90
Tb	0.68	0.54	0.40	0.87	0.56	0.19	3.17	0.14	0.12	0.31
Dy	4.08	2.83	1.88	4.40	2.61	0.98	21.37	0.73	0.60	1.60
Ho	0.77	0.47	0.18	0.65	0.40	0.16	4.90	0.11	0.07	0.22
Er	2.19	1.32	0.65	1.82	1.01	0.45	15.25	0.30	0.22	0.71
Tm	0.42	0.16	0.05	0.21	0.12	0.06	2.34	0.04	0.02	0.07
Yb	2.30	1.14	0.39	1.31	0.79	0.38	15.53	0.25	0.21	0.58
Lu	0.34	0.16	0.04	0.19	0.12	0.05	2.45	0.03	0.02	0.08
Be	<3	<3	<3	<3	4.00	<3	<3	<3	<3	<3

	Felsic and intermediate intrusive rocks, cont'd					Mafic and ultramafic intrusive rocks				
Sample	99-034a	99-038a	99-071d	99-501d	99-602a	98-001a	98-010a	99-016c	99-039a2	99-039a4
Township	Sheba	Tolstoi	Nordica	Timmins	McEvay	Sheraton	Sheraton	Timmins	Nordica	Nordica
Rock Type	granodio.	granodio.	granodio.	granodio.	granodio.	gabbro	gabbro	gabbro	ol gabbnor	ol gabbnor
SiO2 (%)	68.90	70.80	68.23	71.01	68.75	45.04	47.96	50.46	36.61	38.58
TiO2	0.21	0.18	0.23	0.29	0.28	1.53	0.46	0.68	0.21	0.19
Al2O3	15.56	14.55	15.55	15.58	15.56	13.55	16.14	12.10	6.58	5.67
Fe2O3	1.74	1.39	2.15	1.49	2.68	16.69	8.60	9.51	16.60	16.01
MnO	0.03	0.02	0.03	0.02	0.05	0.16	0.13	0.16	0.14	0.14
MgO	1.00	1.20	1.29	0.62	1.55	6.88	10.90	11.71	26.27	24.99
CaO	2.16	0.70	1.91	1.80	2.27	10.61	7.96	8.42	3.03	4.64
Na2O	5.60	5.70	5.73	4.91	6.80	1.98	2.34	2.48	0.14	0.20
K2O	2.73	3.28	2.57	3.80	1.80	0.67	1.31	1.32	0.01	0.02
P2O5	0.08	0.07	0.10	0.12	0.11	0.03	0.07	0.17	<0.01	<0.01
LOI	0.93	1.05	1.41	0.58	0.99	2.34	2.90	2.49	7.70	7.02
S	NA	NA	NA	NA	NA	NA	NA	NA	0.58	0.99
Total	98.94	98.94	99.20	100.22	100.84	99.48	98.77	99.50	97.87	98.45
Cr (ppm)	46	40	56	16	59	104	475	>500	>500	>500
Ni	18	14	26	6	23	128	330	323	1038	1456
Co	5	<5	8	<5	5	57	41	42	99	149
Sc	2	2	3	2	4	51	24	19	11	15
V	26	19	24	20	44	744	136	155	144	152
Cu	6	<5	47	<5	14	174	<5	15	339	488
Pb	22	8	11	21	4	NA	NA	4	4	32
Zn	51	42	66	55	48	102	74	101	117	138
W	<40	<40	<40	<40	<40	<40	<40	<40	<40	<40
Mo	<8	<8	<8	<8	<8	<8	12.00	<8	<8	<8
Rb	79	86	54	70	40	19	47	52	1	1
Cs	2.20	1.19	0.57	0.99	0.36	0.45	0.91	1.38	0.65	0.73
Ba	1592	1292	1639	1468	1186	169	249	506	<5	8
Sr	1180	482	979	1056	569	122	230	265	5	8
Ga	19	18	20	20	19	NA	NA	16	7	7
Ta	0.25	0.20	0.13	0.17	0.23	0.22	0.28	0.15	0.01	0.04
Nb	3.5	3.5	3.2	3.2	4.7	0.9	1.6	2.7	0.2	0.3
Hf	3.04	2.96	2.23	3.72	2.84	0.57	0.71	2.38	0.18	0.21
Zr	99	94	79	135	107	24	53	84	6	9
Y	4	4	5	3	8	13	12	15	2	3
Th	3.93	3.98	2.56	6.08	3.50	0.10	0.50	3.55	0.02	0.05
U	0.92	1.16	1.17	0.96	0.93	0.04	0.11	0.77	0.00	0.03
La	12.33	10.17	13.28	31.04	20.49	2.09	4.58	33.67	0.99	1.10
Ce	27.96	22.48	26.00	69.56	42.86	5.00	12.21	61.11	1.94	2.43
Pr	3.46	2.46	2.99	7.48	4.83	0.73	1.86	7.71	0.23	0.31
Nd	13.20	9.52	11.88	27.30	18.91	3.73	8.44	30.10	0.98	1.41
Sm	2.29	1.72	2.16	4.42	3.23	1.25	2.02	5.27	0.22	0.30
Eu	0.86	0.63	0.85	1.19	0.96	0.61	0.68	1.33	0.08	0.13
Gd	1.62	1.26	1.52	2.61	2.46	1.75	1.92	4.06	0.34	0.40
Tb	0.18	0.16	0.20	0.26	0.28	0.32	0.31	0.56	0.05	0.07
Dy	0.83	0.72	0.78	0.73	1.41	2.14	1.94	2.70	0.36	0.50
Ho	0.15	0.12	0.15	0.10	0.26	0.50	0.42	0.53	0.09	0.11
Er	0.32	0.32	0.34	0.20	0.71	1.45	1.24	1.44	0.24	0.31
Tm	0.06	0.07	0.07	0.03	0.12	0.21	0.18	0.21	0.04	0.06
Yb	0.41	0.40	0.44	0.25	0.84	1.45	1.18	1.27	0.26	0.36
Lu	0.08	0.06	0.06	0.03	0.12	0.23	0.19	0.20	0.03	0.06
Be	<3	<3	<3	<3	<3	5.00	<3	<3	<3	<3

Mafic and ultramafic intrusive rocks, cont'd

Sample	99-066c	99-069a2	99-069b3	99-069c2	99-070a	99-070c	99-071c	99-073a1
Township	Timmins	Nordica	Nordica	Nordica	Nordica	Nordica	Nordica	Timmins
Rock Type	gabbro	troctolite	ol gabbnor	amph	troctolite	amph	chromitite	gabbro
SiO2 (%)	45.09	41.89	44.96	46.93	40.51	43.59	50.34	41.75
TiO2	0.72	0.09	0.38	0.90	0.08	1.56	2.05	2.44
Al2O3	10.71	17.81	7.86	3.60	16.36	2.75	12.99	15.89
Fe2O3	10.83	8.20	13.12	18.24	9.92	20.44	18.87	22.33
MnO	0.27	0.12	0.18	0.25	0.14	0.32	0.33	0.10
MgO	12.69	15.22	17.33	14.01	17.91	15.45	3.11	4.44
CaO	13.98	11.16	8.68	12.65	8.76	8.21	8.38	8.33
Na2O	0.59	0.88	0.99	0.68	0.85	0.52	2.55	2.32
K2O	1.04	0.55	2.56	0.08	0.27	0.04	0.32	0.82
P2O5	0.76	<0.01	<0.01	0.01	<0.01	0.01	0.35	0.07
LOI	2.39	4.08	1.88	1.88	4.62	3.11	0.57	2.18
S	NA	NA	<0.01	1.64	NA	2.54	<0.01	NA
Total	99.07	100.00	97.94	100.87	99.42	98.54	99.86	100.67
Cr (ppm)	>500	489	>500	>500	245	>500	>500	15
Ni	256	329	639	529	846	1376	799	41
Co	45	58	72	140	71	204	175	46
Sc	23	8	15	76	7	53	16	29
V	191	47	298	450	37	557	1015	406
Cu	9	42	8	987	576	2072	10	68
Pb	7	1	4	4	1	1037	27	4
Zn	189	65	172	121	66	3594	670	70
W	<40	<40	<40	<40	<40	<40	84.00	<40
Mo	<8	<8	<8	<8	<8	<8	<8	<8
Rb	17	16	113	1	8	1	40	24
Cs	0.40	0.51	11.02	0.06	0.39	0.17	5.47	1.10
Ba	1495	70	191	9	29	13	195	179
Sr	981	96	29	9	40	8	32	104
Ga	16	10	11	8	9	7	43	21
Ta	0.28	0.01	0.09	0.06	0.02	0.07	0.04	0.20
Nb	5.7	0.1	1.3	0.8	0.1	0.8	0.8	3.2
Hf	5.55	0.19	0.29	0.92	0.21	0.82	0.56	1.68
Zr	241	8	9	29	7	21	20	58
Y	34	2	15	22	2	16	5	23
Th	11.15	0.02	0.07	0.14	0.02	0.18	0.07	0.28
U	2.21	0.02	0.04	0.32	0.00	0.12	0.06	0.30
La	85.86	0.54	1.56	1.54	0.37	1.11	0.41	8.93
Ce	184.30	0.81	5.99	4.86	0.72	3.44	1.01	21.04
Pr	24.37	0.13	1.01	0.74	0.12	0.59	0.16	2.92
Nd	101.73	0.63	5.13	4.35	0.54	2.89	1.04	12.92
Sm	18.94	0.15	1.88	1.76	0.16	1.23	0.36	3.22
Eu	4.47	0.13	0.47	0.40	0.15	0.28	0.13	1.66
Gd	13.69	0.23	1.93	2.16	0.17	1.60	0.48	3.39
Tb	1.64	0.04	0.34	0.45	0.03	0.30	0.10	0.55
Dy	6.97	0.30	2.31	3.54	0.23	2.54	0.82	4.05
Ho	1.18	0.06	0.53	0.82	0.07	0.55	0.17	0.84
Er	2.75	0.18	1.58	2.35	0.21	1.69	0.58	2.51
Tm	0.39	0.04	0.25	0.38	0.04	0.30	0.10	0.43
Yb	2.29	0.20	1.49	2.26	0.26	1.73	0.54	2.51
Lu	0.30	0.03	0.23	0.36	0.03	0.29	0.09	0.42
Be	<3	<3	<3	3.00	<3	3.00	6.00	<3

Appendix 2

Drill hole locations and information.

NUMBER	EASTING	NORTHING	COMPANY	DRILL HOLE NAME	TOWNSHIP
98-CMV-100	518563	5364551	GOLDEN KNIGHT	SK-97-1	SHERATON
98-CMV-101	518232	5365168	GOLDEN KNIGHT	SKG-97-3	SHERATON
98-CMV-102	517778	5364940	GOLDEN KNIGHT	SKG-97-5	SHERATON
98-CMV-103	518260	5365496	GOLDEN KNIGHT	SKG-97-6	SHERATON
98-CMV-104	516722	5362952	GOLDEN KNIGHT	SK-97-8	SHERATON
98-CMV-105	517958	5365032	GOLDEN KNIGHT	SKG-97-12	SHERATON
98-CMV-106	518033	5364898	GOLDEN KNIGHT	SKG-97-13	SHERATON
98-CMV-107	516990	5363118	GOLDEN KNIGHT	SK-97-18	SHERATON
98-CMV-108	516245	5364645	GOLDEN KNIGHT	SK-98-22	SHERATON
98-CMV-109	517051	5362835	GOLDEN KNIGHT	SK-98-24	SHERATON
98-CMV-201	518520	5362780	CROSS LAKE	CLS-93-1	SHERATON
98-CMV-202	518740	5362280	CROSS LAKE	CLS-93-2	SHERATON
98-CMV-203	518520	5362070	CROSS LAKE	CLS-93-3	SHERATON
98-CMV-204	517580	5361980	CROSS LAKE	CLS-93-4	SHERATON
98-CMV-205	517329	5363592	CROSS LAKE	CLS-97-16	SHERATON
98-CMV-206	517503	5363286	CROSS LAKE	CLS-97-29	SHERATON
98-CMV-207	517483	5363142	CROSS LAKE	CLS-98-53	SHERATON
98-CMV-208	516227	5362091	CROSS LAKE	CLS-98-58	SHERATON
98-CMV-209	517366	5363013	CROSS LAKE	CLS-98-59	SHERATON
98-CMV-210	516243	5362200	CROSS LAKE	CLS-98-60	SHERATON
98-CMV-211	515931	5361823	CROSS LAKE	CLS-98-61	SHERATON
98-CMV-300	519665	5366060	UNIGOLD	UB-87-3	SHERATON
98-CMV-301	519345	5366050	UNIGOLD	UB-87-2	SHERATON
98-CMV-302	518295	5365070	UNIGOLD	UB-87-5	SHERATON
98-CMV-303	519165	5365945	UNIGOLD	UB-87-6	SHERATON
98-CMV-400	519780	5366200	SEEWAY	SW-72-1	SHERATON
98-CMV-401	519800	5366150	SEEWAY	SW-72-2	SHERATON
98-CMV-402	519770	5366170	SEEWAY	SW-72-3	SHERATON
98-CMV-403	519495	5366205	SEEWAY	SW-72-5	SHERATON
98-CMV-500	514575	5361995	LAKE MINERALS	SH-TR-1	SHERATON
98-CMV-501	515855	5360950	LAKE MINERALS	SH-3B	SHERATON
98-CMV-502	516045	5362505	LAKE MINERALS	SH-5A	SHERATON
98-CMV-503	520193	5359738	LAKE MINERALS	SH-14A	SHERATON
98-CMV-600	516530	5364520	COMINCO	R-1	SHERATON
98-CMV-601	516520	5364210	COMINCO	RA-2A	SHERATON
98-CMV-700	516905	5364655	MOREAU/WOODWARD	S#9	SHERATON
98-CMV-900	514188	5358936	VENTEX	WR-88-1	SHERATON
98-CMV-901	514740	5358927	VENTEX	WR-88-2	SHERATON
98-CMV-902	514644	5358396	VENTEX	WR-88-3	SHERATON
98-CMV-903	513016	5359742	VENTEX	WR-89-4	THOMAS
98-CMV-904	511948	5359396	VENTEX	WR-89-5	THOMAS
98-CMV-905	513184	5365329	NORANDA	TH-83-1	THOMAS

Appendix 2 - Continued.

NUMBER	EASTING	NORTHING	COMPANY	DRILL HOLE NAME	TOWNSHIP
99-CMV-200	516320	5349624	GUENTHER	T#1-83	TIMMINS
99-CMV-201	517512	5348615	ROYAL OAK	TT-95-1	TIMMINS
99-CMV-202	517870	5349200	ROYAL OAK	TT-95-3	TIMMINS
99-CMV-203	516953	5349381	ROYAL OAK	TT-95-11	TIMMINS
99-CMV-204	517966	5348514	ROYAL OAK	TT-96-4	TIMMINS
99-CMV-205	516727	5349823	ROYAL OAK	TT-96-14	TIMMINS
99-CMV-206	516555	5349547	ROYAL OAK	TT-96-15	TIMMINS
99-CMV-207	517894	5350647	ROYAL OAK	TT-96-16	TIMMINS
99-CMV-208	516649	5348827	ROYAL OAK	TT-97-10	TIMMINS
99-CMV-209	517327	5350641	CANALASKA	TT-98-01	TIMMINS
99-CMV-210	517115	5349201	CANALASKA	TT-98-02	TIMMINS
99-CMV-211	518677	5354058	CANALASKA	TT-98-03	TIMMINS
99-CMV-212	518512	5356329	CANALASKA	TT-98-04	TIMMINS
99-CMV-213	517939	5356204	CANALASKA	TT-98-05	TIMMINS
99-CMV-214	521420	5353700	DRC	T-98-1	TIMMINS
99-CMV-215	521616	5353858	DRC	T-98-2	TIMMINS
99-CMV-216	521632	5354108	DRC	T-98-3	TIMMINS
99-CMV-217	521689	5353678	DRC	T-98-4	TIMMINS
99-CMV-218	516880	5349622	CANALASKA	TT-99-01	TIMMINS
99-CMV-219	516507	5348907	CANALASKA	TT-99-02	TIMMINS
99-CMV-220	516414	5349485	CANALASKA	TT-99-03	TIMMINS
99-CMV-221	516498	5350084	CANALASKA	TT-99-04	TIMMINS
99-CMV-222	529546	5344268	BAND ORE	NW-98-1	NORDICA
99-CMV-223	529626	5344400	BAND ORE	NW-98-2	NORDICA
99-CMV-224	529546	5344267	BAND ORE	NW-98-3	NORDICA
99-CMV-225	528503	5344689	BAND ORE	NW-98-4	NORDICA
99-CMV-226	530727	5353502	VALLIERE		McEVAY

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Metric Conversion Table

Conversion from SI to Imperial			Conversion from Imperial to SI		
SI Unit	*Multiplied by*	*Gives*	*Imperial Unit*	*Multiplied by*	*Gives*
		LENGTH			
1 mm	0.039 37	inches	1 inch	**25.4**	mm
1 cm	0.393 70	inches	1 inch	**2.54**	cm
1 m	3.280 84	feet	1 foot	**0.304 8**	m
1 m	0.049 709	chains	1 chain	20.116 8	m
1 km	0.621 371	miles (statute)	1 mile (statute)	**1.609 344**	km
		AREA			
1 cm^2	0.155 0	square inches	1 square inch	**6.451 6**	cm^2
1 m^2	10.763 9	square feet	1 square foot	**0.092 903 04**	m^2
1 km^2	0.386 10	square miles	1 square mile	2.589 988	km^2
1 ha	2.471 054	acres	1 acre	0.404 685 6	ha
		VOLUME			
1 cm^3	0.061 023	cubic inches	1 cubic inch	**16.387 064**	cm^3
1 m^3	35.314 7	cubic feet	1 cubic foot	0.028 316 85	m^3
1 m^3	1.307 951	cubic yards	1 cubic yard	0.764 554 86	m^3
		CAPACITY			
1 L	1.759 755	pints	1 pint	0.568 261	L
1 L	0.879 877	quarts	1 quart	1.136 522	L
1 L	0.219 969	gallons	1 gallon	**4.546 090**	L
		MASS			
1 g	0.035 273 962	ounces (avdp)	1 ounce (avdp)	28.349 523	g
1 g	0.032 150 747	ounces (troy)	1 ounce (troy)	**31.103 476 8**	g
1 kg	2.204 622 6	pounds (avdp)	1 pound (avdp)	**0.453 592 37**	kg
1 kg	0.001 102 3	tons (short)	1 ton (short)	**907.184 74**	kg
1 t	1.102 311 3	tons (short)	1 ton (short)	**0.907 184 74**	t
1 kg	0.000 984 21	tons (long)	1 ton (long)	**1016.046 908 8**	kg
1 t	0.984 206 5	tons (long)	1 ton (long)	**1.016 046 90**	t
		CONCENTRATION			
1 g/t	0.029 166 6	ounce (troy)/ ton (short)	1 ounce (troy)/ ton (short)	34.285 714 2	g/t
1 g/t	0.583 333 33	pennyweights/ ton (short)	1 pennyweight/ ton (short)	1.714 285 7	g/t

OTHER USEFUL CONVERSION FACTORS

	Multiplied by	
1 ounce (troy) per ton (short)	31.103 477	grams per ton (short)
1 gram per ton (short)	0.032 151	ounces (troy) per ton (short)
1 ounce (troy) per ton (short)	20.0	pennyweights per ton (short)
1 pennyweight per ton (short)	0.05	ounces (troy) per ton (short)

Note: Conversion factors which are in bold type are exact. The conversion factors have been taken from or have been derived from factors given in the Metric Practice Guide for the Canadian Mining and Metallurgical Industries, published by the Mining Association of Canada in co-operation with the Coal Association of Canada.